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TELEPHONE ENGINEER

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Editorial Mention

Eliminate Waste

At a meeting of engineers and technologists from all sections of the country held at Syracuse, N. Y., recently the proceedings were opened with the announcement by Herbert Hoover, president of the American Engineering Council of the Federated American Engineering Societies, of the appointment of a committee on elimination of waste in industry.

The appointment of this committee, according to Mr. Hoover, marks the beginning of what is officially styled by this council as a great national assay of waste, in which from 100,000 to 200,000 engineers functioning through the council will attempt by studying the nation as a single industrial organism to locate the weaknesses in the country's production system.

A preliminary survey, it is announced, has already been organized and the different elements making for production waste, such as labor conflict, decrease in individual productivity, lack of co-ordination, and many other sources of industrial failure will be brought under the close scrutiny of the organized engineers of the nation with the aim of solving pressing economic problems.

Unemployment, intermittent employment, strikes, lockouts and restrictions of output are waste. Disuse and misuse of machinery and equipments and losses of manufacturing materials are likewise waste. Stabilization of industry is a crying need, and also an engineering problem. Labor, capital, management and the consuming public stand to gain if common constructive action can be taken to lessen the idleness of men, idleness of productive equipment and the utilization of material.

It is proposed to organize the engineers of the country on a territorial basis, each state having an engineering organization, with the American Engineering Council the executive organ of all.

The committee has already started work and a nation-wide plan described is the most ambitious movement in the direction of solving economic problems ever undertaken by American engineers.

Visit Your Exchange

Mr. F. D. Fancher, general manager of the Orange County Telephone Co. at Middletown, N. Y., calls our attention to an unsolicited editorial in his local paper. The editorial is constructive and contains an excellent idea for other telephone managers to use. We append it in full:

Announcement in The Herald of Wednesday evening to the effect that the Orange County Telephone Company had extended an invitation to the school children of the city to visit its plant and make an inspection thereof is interesting. The invitation was extended through the Board of Education. The idea is to educate the children regarding the really wonderful machinery, plant and organization which make the telephone convenience possible.

While the children are about it they might ask some of their parents to go along. It might make some of them more patient with the telephone company. If people could see the tremendous difficulties that have to be overcome every day; the intricate problems that have to be solved, and the obstacles that have to be met and surmounted, they would be less inclined to be snappish with central when they were unable to get a number the very instant they ask for it. A telephone system is one of the most delicate and difficult to maintain. The least break in one of the thousands of miles of wire causes trouble somewhere along the line; an ice and sleet storm, or a heavy electrical storm, plays havoc with the service, and a hundred and one things may happen to disturb the sensitive organization and stop it from functioning properly. Against all these contingencies the staff of the telephone company must constantly do battle. The men must be ready at all times to brave the elements in order to maintain the service. It is not an uncommon thing for telephone linemen to be on the job all night long in order that you, Mr. Subscriber, may take down your receiver in the morning and talk to a business associate without a minute's delay.

Complaints about the telephone service are unjustified and unjust. In the first place the service is good—much better and much faster here than it is in some cities, and, in the second place, it is much faster than we have a right to expect it to be considering what the service costs.

One has but to look a few years, if one is old enough, and compare the service today with what it was in the early days of telephony; and one has but to think what modern business and social life would be without the telephone to appreciate what it means to our complex civilization. It would be a good thing if all critics of the telephone service would pay a visit to the central office—just as the school children have been invited to do—they would come away with a different attitude of mind and be more inclined to boost than knock.

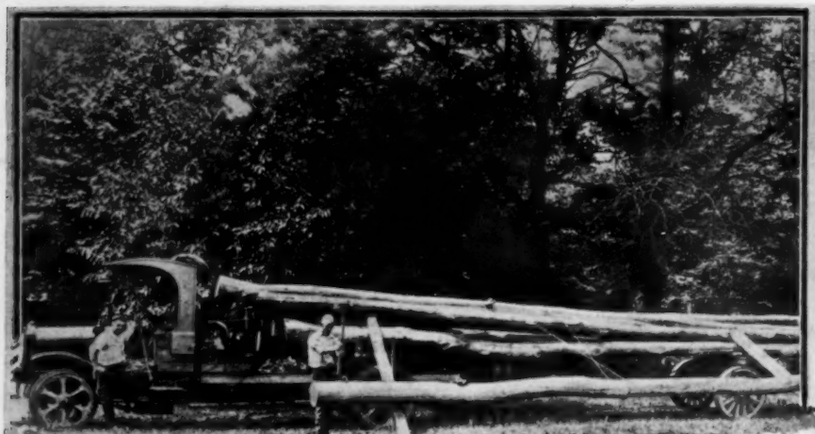
England's Telephones

B. G. Hubbell, of New York, who is spending the winter on the Continent, has sent TELEPHONE ENGINEER considerable information as to telephone rates and service in England. Conditions have become so bad both as to charges and service that the whole matter may be presented to parliament for solution.

A. J. Hopson, president of the Associated Chambers of Commerce, says the present methods are so hopelessly inefficient—"a standing example of how not to do things," and a warning against the nationalizing of any other section of industry.

Many authorities are in favor of measured service instead of the present flat rate. A prominent member of parliament states the matter very clearly when he says: "It seems to me to be obvious that as a general principle the user should pay for such service as he obtains."

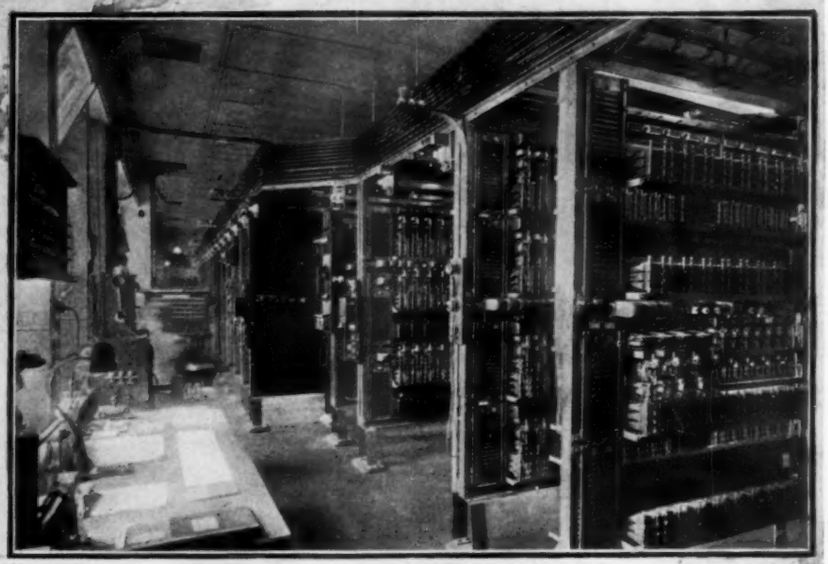
Under government ownership the telephone service of Britain is a joke and Englishmen are coming to see it. Just what action parliament will take to give England more modern telephone service remains for the future to determine.



Truck and trailer used by New York Telephone Company to transport and distribute poles.

A new practical telephone which allows free use of the hands to write while receiving messages.

Wireless telephone and switchboard now used by many brokerage houses.



The interior of an automatic exchange in Germany, where it is the plan to use automatic equipment extensively.

National Maximum Production

Abstract of an Address Before the American Engineering Council at Syracuse, N. Y., February 14th, on Industrial Waste

By HERBERT HOOVER.
President American Engineering Council.

THE Federation of Engineering Societies has been brought about solely that we might secure for public service the collective thought and influence of 100,000 to 200,000 of our professional engineers. This great body of men in administrative and technical service penetrate every industrial avenue and thus possesses a unique understanding of many of our intricate economic problems and an influence in their solution not equaled by any other part of the community. Wanting nothing from the public either individually or as a group, they are indeed in a position of disinterested service. This federation has initiated service to the public in many directions.

I propose to deal with only one measure of this service today. Your council has organized a preliminary survey of some of the weaknesses in our production system. This survey will attempt to visualize the nation as a single industrial organism and to examine its efficiency towards its only real objective, the maximum production. In a general way this inquiry will bear upon the whole question of deficiency in production—industrial waste in a broad sense.

The waste in our production is measured by the unemployment, the lost time due to labor conflict, the losses in labor turnover, the failure to secure maximum production of the individual due either to misfit or lack of interest. Beyond this again is a wide area of waste in the poor co-ordination of great industries, the failures in transportation, coal and power supplies which re-echo daily to interrupt the steady operation of industry. There are again such other wastes due to lack of standardization, to speculation, to mismanagement, to inefficient national equipment and a hundred other causes. There is a certain proof of deficient production by comparisons of our intense results in 1918, when, with 20 percent of our man-power withdrawn into the army, we yet produced 20 percent more commodities than we are doing today. We are probably not producing more than 60 or 70 percent of our capacity; that is, if we could synchronize all national effort to maximum production, we could produce 30 or 40 percent more commodities and service. Our national machine is today worse than usual, as witness the 3,000,000 idle men walking our streets. One part of the human measure of this shortage in production is the lack of necessities or comforts to them and their families, and their anxieties as to the future.

No one will ever suppose that it is ever possible to bring national productivity up to the full 100, but the whole basis of national progress, of an increased standard of living, of better human relations, indeed of the advancement of civilization, depends upon the continuous improvement in productivity. While we currently assume that great advances in living standards are brought about by new and basic invention, yet in fact even a greater field of increasing standards lies in the steady elimination of these wastes. The primary duty of organized society is to enlarge the lives and increase the standards of living of all the people—not of any special class whatever. We are therefore proposing to make a preliminary examination of the volume of waste in certain industries, the proportions that lie in each field of fault. And no engineering report is worth the paper it is written upon without constructive suggestions in remedy.

There is ofttimes a superficial dismissal of this subject of maximum production on the assumption that there are positive limits in production due to over-supply. Such assumption has no proper foundation in the broad view of industry as a whole. Too much economic thought on production has delimited its boundaries by the immediate volume of demand of a given commodity. There is no such thing as the nation over-production, if it produces the right commodities. The commodities or services produced by the whole nation are capable of absorption by the whole nation if they are of the right character. In other words, if we could attune the whole industrial machine to the highest pitch, agriculture as well as manufacture, an increasing production would mean a directly increasing standard of living. When ten men or one hundred million men divide their united output, they can by doubling their output have twice the amount to divide. The problem in doubling output is to direct it to commodities or services that they can use. There is no limit to the increase of living standards except the limitations of human strain, scientific discovery, mechanical invention and natural resources.

It is true enough that any particular commodity or service can be over-produced, for each will reach a saturation point in demand all the members of the community have been supplied. The absorption of increased productivity lies in the conversion of luxuries of today into necessities of tomorrow, and to spread these through the whole population by stimulation of habit and education. Wheat bread, railways, good roads, electricity, telephones, telegraphs, automobiles and movies were once luxuries. They are still luxuries to some parts of the population.

It is but a corollary that certain commodities can better be produced for exchange for commodities from outside our boundaries of more appropriate character to our needs. Today we have capacity for production of some commodities not only in excess of our home need, but even beyond expert demand under present financial conditions. As a matter of practical remedy, we must either reorganize these financial relations or alternately abandon some part of this kind of production and turn our idle men to making things of which we are not yet fully supplied.

To put the matter in another way, there is no limit to consumption except the total capacity to produce, provided the surplus of productive power is constantly shifted to new articles from those that have reached the saturation point of demand. For instance, we have the productive capacity wasted today that would improve the housing conditions of our entire people to the level that perhaps only 50 percent of them enjoy—and at the same time not entrench upon our established necessities. I am not suggesting that the forces of production can be shifted by imperial direction. The practical thing that can be done is to eliminate some of the wastes and misfits in our production, and depend upon the normal processes of business and human desires to absorb them.

The largest area of waste lies in the large periods of slack production and unemployment, due to the ebb and flow of economic tides between booms and slumps. The ideal would be steadily increasing production—an ideal of no likelihood of exact realization because of inability to ever gauge the advance in

growth consumption or the approach of saturation. On the other hand, there are certain possibilities of stabilization worth consideration. For instance, we can classify labor into that engaged in production and service from this equipment. Our studies of industries as a whole show that we usually expand our equipment just at the periods of maximum demand for their products instead of doing our plant expansion during periods of slack consumption. We thus make double demands on labor and we doubly increase unemployment in periods of reduced consumption. That is indeed one of the factors in our great unemployment today. Everyone knows that for our normal productivity, our transportation facilities are today inadequate. We know that we are insufficiently housed, insufficiently equipped in our public roads and our public utilities; that we need an entire revision of our power supply, that we need expansion of our waterways, and yet armies of idle men are walking the streets. The reasons why this occurs are not far to seek, in that it is at times of high productivity that capital is most easily obtained. It is then that the necessity of increased equipment most impresses men's minds and it is the high hopes of these periods that lead them into the adventure of expansion. Nor is it possible to expect that all industry could be so stabilized as to do its capital construction in periods of depression in commodity demand. Nevertheless, there are some industries that could, by co-operation of the government and co-operation among themselves, be led in this direction. More particularly does this apply to railways, telephones, telegraphs, power supplies and other public utilities, and to the expenditure upon our state, municipal and national public works.

Another variety of intermittent employment, and thus great waste, lies in certain industries now operating upon an unnecessarily wide seasonal fluctuation, as for instance the bituminous coal industry. This is today one of our worst functioning industries. These mines operate seasonally and erratically. They proceed from gluts to famines, from profiteering to bankruptcy. As already determined by our engineering bodies, the men who mine our coal find work only 70 percent of their time. In other words, there are 30 percent more equipment and 30 percent more men attached to this industry than are necessary if it were stabilized to continue operation. The mining engineers have already pointed out the directions in which remedy lies, through storage, through railway rate differentials and other remedies. Through constructive action, an army of men could be released from this industry of necessity to convert some luxury into a necessity of tomorrow. This is no plan to control prices or profits, although through it both the producer and consumer in coal could be placed upon a sounder basis than today. The interest of the consumer and producer, is, however, even less important than relief from the intermittent employment and unemployment within this industry that today brings a train of indefinite human misery and some of our lowest standards of living.

The second largest area of waste in productivity is the great amount of labor friction, strikes and lockouts. The varied social and economic forces involved in this problem needs no repetition here. Fundamentally this is not alone a struggle for division of the results of production between capital and labor, but there is also a loss greater from strikes and lockouts in the element of purely human friction and loss outside the area of dispute on wages and hours. The growth of industry into large units has destroyed the old mutuality of interest between employe and employer. Our repetitive processes have tended to destroy the creative instinct and interest in employes; at times their efforts sink to low levels indeed. We will yet have to reorganize the whole employment relationship to find its solution. There is great promise in this field during the past two years, and the progress in this matter is one of the subjects under our inquiry.

Yet another variety of loss lies in the unnecessarily faulty distribution of our labor supply due to seasonal and to shifting demands. An adequate national employment service is indeed the first need to reduction of these wastes.

Probably the next largest fraction of waste in productivity lies in a too high degree of individualism in certain basic products and tools. In other words, a standardization of certain national utensils makes for economy in distribution, in operation and in repairs. The necessity of maximum production during the war opened a great vista of possibilities in this direction. Such standardization as car couplings, or wheels, and cars generally, represents real progress in this direction. These possibilities lie in a hundred directions. There are all sorts of cases, from sizes of chains to the size of automobile wheels. Today dozens of different sizes are placed in the market by manufacturers and entail not only special equipment and skill to produce these many varieties, but also great stocks are required in distribution and losses are entailed due to lack of interchangeability. It is certain that there are a great many articles of every day use in which the manufacturer would indeed be glad to undertake some co-operation in standardization, from which the saving in national effort would be interpreted not into millions but into billions of dollars. This does not mean that we stamp the individuality out of manufacture or invention or decoration; it means basic sizes to common and everyday things.

Another type of waste lies in our failure to advance our industrial equipment. The Super-Power Board will demonstrate the saving of 25,000,000 to 50,000,000 tons of coal annually by the electrification of our eastern power supply. The St. Lawrence Waterway Commission will demonstrate the saving of five to ten cents a bushel to the farmers of fifteen states by unlocking the lakes to ocean-going vessels. Nor will this added efficiency to our national transport injure our present systems of canals and waterways, for we have ever found that the prosperity of an industry blesses them all.

Nor do we believe it is necessary to effect these things by the government. The spirit of co-operation that has been growing in our country during the last thirty years has already solved many things; it has standardized some things and is ripe for initiative toward co-operation of a widespread character. The leadership of our federal government in bringing together the forces is needed. No greater field of service exists than the stimulation of such co-operation. The first step is sane analysis of weakness and sober proposal of remedy. If the facts can be established to an intelligent people such as ours, action is certain even if it be slow. Our engineers are in unique position for this service, and it is their obligation to carry it forward.

SUCCESS TALKS

HOPE

By S. A. CHANDLER

A man without hope is without a chance to succeed. Lack of hope dulls vision. He sees nothing to urge him on to greater effort, nothing to be gained by greater activity, so won't even try. And the man who won't try is a pre-cinched failure.

But as long as he retains hope he has an opportunity to grow. He is alert to any chance to better himself. He seeks the thing he hopes for, so is prepared to find it and to recognize it when he does.

Hope lifts the veil of doubt in his mind. It makes him see the brighter, result-getting side of things; makes him believe that there is a way out or a way around. And, believing that he will obtain the object of his hope, he will earnestly strive for it. And surely there is hope for the man who will honestly strive for that which he desires.

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Northern White Cedar Association Meeting

Twenty-fifth Annual Convention of the Cedar Men Held at the Radisson Hotel, Minneapolis, February 8

The Northern White Cedar Association held its twenty-fifth annual convention at the Radisson Hotel, Minneapolis, on February 8. In his annual address President L. A. Furlong, of Minneapolis, said in part:

"During the years through which we have just passed we witness the end of a five-year period of wartime inflation and speculation, throughout which time we all lost our perspective of values and unconsciously rose with the wave, knowing that ultimately we must go through a readjustment of values; but few thought it would come as soon or be so drastic.

"During the first half of 1920 we were riding the peak of the wave. Most of our members were able to dispose of their products before the recession begun. I refer to poles, pulpwood, ties and logs. The companies handling posts were not so fortunate, and large stocks of posts are being carried over, with no demand whatever.

"Taking our industry as a whole, we have a lot to be thankful for, if we look around and realize what other businesses have gone through and are still going through. I refer to the lumber, copper, leather, rubber, woolen, cotton and other similar industries. Firms handling these commodities have taken tremendous losses and many old and wealthy concerns have had their capital and surplus entirely wiped out.

"Nothing approaching this has occurred among our members. It is true that there have been some losses taken in inventories of stocks carried over, but there is no company that is not well able to absorb the loss and go ahead this year and do business. On the whole, our members have had a profitable year and are in shape to face the readjustment that is with us today, and with normal conditions will be able to continue and progress.

"But not until this readjustment is completed will a real recovery set in. The chief obstacle to this completion is human stubbornness and unwillingness to face the facts and reluctance of the individual to assume his share of the loss. When this is done, then, and then only, can we look for a real revival of all business.

"The producer and manufacturer have taken their losses, the wholesale his. Labor has taken a part of its, but the retailer, without which labor cannot adjust itself, has taken but a very small percentage. Only when the four are working in union, each bearing his part, can we expect real business progress and prosperity.

"We are starting 1921 with January, as a whole, the poorest business month in years. February should be better, and along later in April and the first of May we should be acquiring a full 'head of steam' and be going ahead on a real normal basis.

"By that time the new administration at Washington will be in charge and our new president will have been inaugurated and will have gathered around him for counsellors and advisors real men whose opinions and suggestions he will invite, listen to, and follow. If he will give us the real business administration that we must have, we need not fear this year or the next four years."

Following the president's address, N. C. Boucher, secretary of the association, presented his annual report showing the year's activities. The membership increased from 44 to 49 by the addition of the following members:

Central Warehouse Lumber Company, Minnesota Transfer, Minn.; Kreeton Company, Johnswood P. O., Drummond Island, Mich.; Northern Cedar & Lumber Co., Blackduck, Minn.; Northern Cedar & Timber Company, Menominee, Mich.; James Reid, Big Fork, Minn.; I. Seery, Butternut, Wis., and Cedar River Lumber Company, Minneapolis.

The association's finance was shown to be in excellent condition from the report of Treasurer H. F. Partridge, of Minneapolis.

The reports of the different committees were read showing the great activity during the year. An appropriation of $7,000 for cedar pole advertising was made during the present year.

The election of officers for the year was as follows: Benjamin Finch, Duluth, president; W. B. Thomas, Manistique, vice president; H. F. Partridge, Minneapolis, treasurer. M. H. Schussler and W. C. Meader, of Minneapolis, were elected directors.

A banquet at the Radisson closed the meeting.

The following is a list of those in attendance:

American Cedar Company, H. S. Gilkey; Baudett Cedar Company, George D. Arnold; Bell Lumber Company, W. C. Meader; Brown Land & Lumber Company, D. D. Comstock; Canadian Cedar & Lumber Company, W. W. Scoville; Central Warehouse Lumber Company, C. P. Bradnober; Coolidge-Schussler Company, M. H. Schussler; Crawford Cedar Company, J. R. Roper; Curry & Whyte Company, D. J. Curry; Duluth Log Company, T. B. Bradley; Erickson & Bissell, C. W. Bissell; Finch Brothers, Benjamin Finch; A. C. Johnson Lumber Company, A. C. Johnson; McCulloch & Moss Lumber Company, W. C. Moss; MacGillis & Gibbs Company, J. E. Gerich; National Pole Company, J. C. Kirkpatrick, H. W. Reade and A. D. McIntyre; Naugle Pole & Tie Company, A. T. Naugle and W. L. Lafean; Northern Cedar & Lumber Company; A. E. Witting; Northern Cedar & Timber Company; W. S. Patch; Page & Hill Company, L. A. Page, Jr., and L. L. Hill; Park Falls Lumber Company, F. O. Nelson; T. M. Partridge Lumber Company, T. M. Partridge and H. F. Partridge; Pendleton & Gilkey, H. S. Gilkey and W. H. Gilkey; James Reid; Republic Cedar Company, M. E. Brown; C. P. Tinkman; Valentine-Clark Company, E. L. Clark and G. W. Willson; Virginia & Rainy Lake Company, A. K. Berger; White Marble Lime Company, W. B. Thomas; I. Seery; Wisconsin Land & Lumber Company, W. B. Earle; Cedar River Lumber Company, Louis Olson.

Saving by Telephone

Few people appreciate the actual money saving to them made possible by their telephone. An investigator of the subject recently took farmers as an example. In order to determine the saving to the farmer the very low figure of 5 cents per mile was allowed for his time and cost of transportation, were he to attempt to do the same work as his telephone. The figures made the farmers look like profiteers.

The figures were based on thirty days' use of the telephone. Subscriber No. 1, farming 160 acres, had 39 business calls in the month which would have consumed traveling 153 miles, had he been forced to physically make the trips. This at 5 cents a mile amounted to $7.65. Subscriber No. 2, farming 320 acres, had 70 business calls, which would have totaled 144 miles, and, computed the same way, his cost would have been $10.80. Subscriber No. 3, farming 906 acres, had 91 business calls, the mileage of which would have totaled 444 miles and, computed at 5 cents a mile, would have amounted to $22.20.

In each case actual experiences of the three farmers were taken.

Wisconsin State Telephone Convention

Telephone Men of the State Attend a Three-Day Meeting at the Republican House, Milwaukee, February 15-17

The annual meeting of the Wisconsin State Telephone Association was held at the Republican House, Milwaukee, on February 15 and 16, with more than 100 telephone men of the Badger state in attendance. President Walter J. Gallon in his opening address spoke of the economic readjustment the telephone industry is going through in common with all other lines of business. "When we are reading our daily papers there are times when we feel quite optimistic, and the sun seems to shine as brightly as of yore; then from a clear sky come clouds which cause oppression. We begin to wonder if civilization as it is today is on the right track.

"We begin to wonder if there is any limit to the ingenuity of the human brain. Our industry, in my estimation, is the most remarkable demonstration of a combination of science and invention. I feel after reading of the developments in the scientific fields at various times that we are on the verge of an evolution in our industry which will throw our present methods entirely into the discards.

"Let us review for a moment what is going on. The inventive genius is taxing his brain to invent methods and means to help the management of telephone properties to give better service—at least I earnestly hope that is their real motive. However, I am inclined to doubt, ofttimes, whether the real motive behind the inventive genius is not the selling end of it.

"During the past year I made it a point to visit many exchanges and watch the development of many inventions that are in the field at the present time. After my trips I came back to my office at a loss as to what to do. I have tried to answer the question, and after careful consideration I believe the question is answered entirely by the patron and the man who pays for the service.

"I have found satisfied patrons in communities where the old magneto type switchboard was still working. I have found satisfied patrons where the first types of common battery switchboards are used and found very much dissatisfied patrons in the exchanges where all the latest types of apparatus were in use.

"In this day and age of state and government control, where the patron has access to the club which forces utilities into line, the question of apparatus, in my estimation, is beginning to become a secondary issue.

"We see efforts on the part of the manufacturer of today to give instantaneous connection. The human equation at each end of the line—by that I mean the two subscribers—seems, in the mind of the inventor, to be taking a secondary place.

"In a well conducted exchange we all know, as telephone men, that the biggest percentage of our troubles are with the patrons themselves. So, after all, what does it mean? It means, gentlemen, that the telephone industry must be closer than ever to its patrons.

"I do not wish to take your time relating instances—we all know them—but I think you will agree with me that the principal trouble today in the telephone industry is with the patrons and not the owners and managers of telephone plants. I have not prepared engineering curves because I know you will all agree that what I have said is mostly true.

"One of the most unfortunate things, in my estimation, today is the fastness and eagerness of civilization to get what it wants regardless of the other fellow. A study of the public press makes us wonder whether the human relationship to one another is going back to the caveman days.

"The spirit of 'get the other fellow' seems to be rampant, and I was wondering if it would not be possible if we, as individuals who are conducting a business that is so vital to human relationship, could not start a humanizing movement in the process of the education of the patron. I believe we have made a fair start at that.

"It is not so many years ago when the damning of the switchboard operator was considered the right thing to do, but today what is it? There is not a conscientious manager anywhere who, when a patron comes to his office condemning the operator, does not bring teeth together and is ready to fight in behalf of the girl at the board.

"I believe this clamor for quick service is over. I believe the word 'instantaneous' should be taken out of our curriculum and the word 'correct' put in its place.

"Might I say a word to the manufacturers? Might I ask you to turn your mind more to simplicity. The idea is that of maintenance. You will agree with me that the telephone maintenance man is gradually becoming a very highly trained specialist, which adds complications to the management of properties and in turn will reuect upon the industry as a whole.

"I am making a plea in behalf of the small plant owners and managers. I believe today we have reached the peak of the cost of telephone service to the patron. I may be condemned for talking as I have, but I have spoken as my heart and conscience dictates. The day of more sincere co-operation and closer contact with the patron and the workers in our industry, and higher feeling toward civilization as a whole, is at hand. Let us hope that we live to see the day when the spirit of 'get the other fellow' will be entirely eliminated."

Following the president's address, Jay G. Mitchell, secretary-treasurer of the Illinois Independent Telephone Association, addressed the convention on "Some Phases of Public Utility Regulation," after which the following committees were named by the president:

Registration: Joseph N. Baillie, Madison; A. H. Bowden, Almond; George Beyer, Wesby.

Credentials: J. L. Farrington, Rio; B. E. Peterson, Stetsonville; and W. H. Phelps, Winslow, Ill.

Resolutions: F. M. McEniry, Milwaukee; H. A. Price, Markesan; and Frank L. Eldridge.

Entertainment: T. N. Moore, Madison, and J. E. Carroll, Mauston.

Auditing: Melvin Halverson, New Richmond, and D. J. Mahoney, Rhinelander.

SECOND DAY'S SESSION.

At the beginning of the second day's session of the convention the secretary's report was read, after which Secretary John A. Pratt talked to the members at some length, reviewing the past year and pointing out many things to be done during the coming year.

The reports of the credentials and auditing committees were then read and accepted.

"The National Safety Code" was the subject of an interesting discussion presented by C. B. Hayden, of Madison, service engineer of the Wisconsin Railroad Commission. Mr. Hayden stated that the National Safety Code consists of rules for safe electric construction and fire prevention. The code has been tentatively in effect in Wisconsin for two years and is being revised to correct faults and to further correlate the Wisconsin code with that of the United States Bureau of Standards, and also to meet the requirements of the state industrial commission.

Following Mr. Hayden, Jay G. Mit-

chell, secretary-treasurer of the Illinois Independent Telephone Association, talked to the members on the telephone conditions and problems in Illinois.

After the general discussion on Mr. Mitchell's remarks, the nominating committee reported the names of W. E. Lawton, Viroqua, and Arthur Taylor, of Rhinelander, for directors. They were elected unanimously, after which the meeting adjourned for the day.

THIRD DAY'S SESSION.

At the opening of the meeting President Gallon announced the directors had re-elected all the old officers, which met with the approval of the delegates.

Frank Herwig, director of the Wisconsin Utilities Bureau, explained the organization and work of the bureau.

Meetings of the Wisconsin bureau are held twice a month, and Mr. MacGovern extended a cordial invitation to all telephone men when in the city to attend them. He invited criticisms of a constructive nature at all times.

S. R. Edwards, Chicago, briefly outlined the activities of the Illinois Committee on Public Utility Information in the preparation of items for publication in newspapers, bulletins for use in the schools, for use of employes of the utility companies, as well as speakers' bulletins.

A discussion of the matter of general publicity was participated in by P. J. Welrich, of Monroe, W. R. MacGovern, H. A. Price, C. A. Blair, of Boscobel, and E. C. Kast, of Minneapolis.

F. B. MacKinnon, Washington, D. C., president of the United States Independent Telephone Association, was the next speaker.

After a general discussion of the work of the United States association during the past seven years in connection with the working out of the competitive telephone company problems and of the every-day services being performed by the association for its member companies, Mr. MacKinnon stated that of the three great problems which the association must assist in solving—the problem of the competitive plant, of the manufacturer, and of the non-competitive plant—the last is the most difficult of solution.

"The danger point of the telephone industry is reached when in the minds of the public there is but one system—that competition no longer exists. The protection of the industry against public ownership rests in the belief by the public that competition exists."

F. H. Runkel, Portage, then spoke on "Inductive Interference," and after a general discussion of the subject the convention adjourned, after passing resolutions on the deaths of Ernest B. Fisher and James L. Moore.

Kansas Association Holds Annual Convention

Three-Day Meeting at Salina, Kansas, Marked By Large Attendance and Most Interesting Program

THE Kansas Independent Telephone Association held its annual convention at Salina, Kan., on Feb. 1-3, with nearly 300 telephone men in attendance. The program was comprehensive and much constructive work was done in the three days' session.

J. D. Waters of Bonner Springs, vice-president of the organization, called the meeting to order, the president, T. L. Youmans of Osawatomie, being absent on account of illness. F. D. Blunder made the address of welcome for Salina and was responded to by J. W. Berry of Jewell City, after which the minutes and the reports of the secretary and treasurer were read and approved.

The round table, in charge of William Green of Abilene, and Philip Hogan of Kansas City, was an interesting feature of the convention, the discussions on plant and equipment being of more than passing interest.

The second day's session was conducted by President T. L. Youmans who had sufficiently recovered from his illness to attend the convention and preside. He appointed a number of committees as follows:

Resolution Committee—H. L. Harris, Kansas City; J. W. Berry, Jewell; Foster Lanning, Tonganoxie; J. A. McDonald, La Harpe, and E. P. Frantz, Conway Springs.

Nominating Committee—Samuel Tucker, Pleasanton; Geo. W. Shifflet, Caldwell; George Scoresby, Sterling; J. A. Gustafson, Fredonia, and F. M. Hagerman, Pratt.

After the appointment of these committees the president introduced E. L. Chase of Kansas City who presented a paper, "Why Publicity and What the Newspapers Want." Mr. Chase imparted much valuable information on telephone publicity and gave many pointers on this phase of the business. Mr. Chase was followed by Pliny Simpson, service and equipment inspection for the Kansas Industrial Court, who explained the duties of his office and offered suggestions particularly as to plant and equipment maintenance service.

F. B. MacKinnon, president of the United States Independent Telephone Association, then addressed the convention on "Rates and the Financial Condition of Telephone Companies in Kansas." He urged the telephone men to get their financial affairs right as soon as possible and emphasized the fact that unless they attended to this matter soon, disaster would follow. He declared they no longer continue drifting, for their plants were wearing out, and they must stir themselves to keep them up properly for better service which the public was going to require from now on.

The next speaker was Paul Grady of the Utilities Engineering & Audit Company of Topeka, who spoke in place of John M. Kinkel on "Telephone Service."

A resolution was carried unanimously that the Kansas Independent Telephone Association, through its executive committee, back up any telephone company in any case that is properly prepared and when justice may not be had in the industrial court or public utilities commission, it be prepared to take the matter into the district court, if necessary.

The afternoon session was followed by a banquet at the Elks' club at which Keith Clevenger, Charles Swartz and other telephone men spoke.

At the opening of the Thursday morning session, Keith Clevenger made an address on "Publicity," showing the many advantages to be gained by proper publicity.

The operators' school was so successful that it was decided to give more time this important subject at future meetings of the organization.

The nominating committee then recommended the following officers and executive committee for the year:

President—T. L. Youmans, Osawatomie.

Vice-president—J. D. Waters, Bonner Springs.

Executive Committee—A. J. Stevens, Hiawatha; J. W. Berry, Jewell City; Fred Coulson, Abilene; H. L. Harris, Kansas City; Samuel Tucker, Pleaston; C. C. Raymond, Greensburg; and J. A. Gustafson, Fredonia.

The report was adopted unanimously and after the secretary cast the ballot of the members for the nominees the convention stood adjourned.

Developments in Telephone Transmission

Concluding Installment of a Paper Read Before the South African Institute of Electrical Engineers

By J. W. KEEFE.

FROM the preceding part of this paper it was shown that the limiting factor in telephone transmission is, or was until recently, the telephone line. Efforts to increase the range of transmission by the production of more efficient or more powerful transmitting and receiving apparatus could not in the nature of the case effect any great improvement. The introduction of loading coils, while increasing very considerably the working range of open wire lines, and making the use of cables possible where their application had up to then been out of the question, also indicated that the practical limit had been arrived at, unless some new method of solving the transmission problem were discovered. At the same time it was evidentt hat if satisfactory transmission could be obtained over still greater lengths of line than was possible even with loading there would be a demand for such telephone service which would result in commercial success, provided of course that the cost factor was not increased out of proportion to the benefits obtained.

Owing to the development of the vacuum tube repeater it may be said without exaggeration that the limits over which speech may be transmitted effectively have been practically removed. It is now possible to hear a person speaking 3,000 miles distant as distinctly as if he were a telephone subscriber in the same local area. The utility to the commercial community in South Africa of being able to speak without difficulty between Capetown and Johannesburg, or, say, Capetown and Bulawayo, would be very great. The cost per message would necessarily be high, but if a business matter is of such importance that a telephone message regarding it may save or gain hundreds or thousands of dollars then the cost of sending such a message would be small compared with the possible resultant benefit.

The apparatus (generally termed a "repeater set") which has been developed in recent years, for achieving such a result acts in such a way that speech currents attenuated by their journey over a long line as amplified and sent on, practically unchanged in form. It is therefore sometimes called a "telephonic relay," or "speech relay." (This term, although not intrinsically wrong, is apt to be misleading as the word relay is almost inseparably associated in the minds of most electrical engineers with an electro-magnetic-mechanical device, which the latest kind of repeater, depending on the action of a vacuum tube, is not.) If the repeater set is properly designed and used with suitably constructed circuits and associated apparatus, several successive repetitions can be made at different points in a very long line, but as will be shown later, it is important that due attention be given to the conditions provided by the line

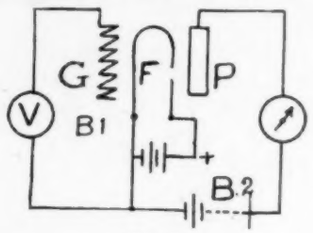


Fig. 9.

and apparatus used, including transmission apparatus, signaling devices, and (in the case of super-imposed working) telegraph apparatus also. Evidently the use of repeaters will cause considerable changes in recognized standards of practice in plant design and construction. For example, it has been found in numerous cases that it is no longer necessary to load overhead lines of large gauge as the desired improvement can be obtained more cheaply by using repeaters. Similarly small gauge conductors, or cables, can be used where formerly conductors of very large gauge would have been necessary.

As a result of the introduction of the repeater, Washington and Boston—about 500 miles apart—are now directly connected by cables, and the system is rapidly being extended to the principal eastern towns of the United States, practically all of the cables now being installed having loaded No. 16 or No. 19 A. W. G. conductors, with repeaters.

ELECTRO-MECHANICAL REPEATERS

The earlier attempts to produce a telephone repeater were based on the obvious plan of causing the diaphragm of the receiver at the end of a section of line to transmit its vibrations directly to that of a transmitter connected to a separate source of power. The electro-mechanical repeater invented about 1904 by H. E. Shreeve (then with the American Bell Telephone Company), which has been continuously improved and was till recently in extensive use, was of this type. Another possible solution of the problem which has been worked on by Drs. Pupin, Campbell and others, is that using for a repeater element a generator whereof the armature would be the output circuit and the field winding the input circuit. Difficulties of commutation, and the high peripheral speed required, and the fact that the impedance of the input circuit was not independent of the frequency of the received current rendered the application of this type of apparatus to commercial telephony impracticable.

The suggestion was made in 1900 by Joseph Lyons to use as a repeater an asynchronous generator, whereof the stator should be bridged across the telephone line and serve both as the input circuit and output circuit, the theory being that the interaction between the stator current received from the line and that induced in the power-driven short-circuited rotor would result in the generation of additional energy of the same wave form as the received current. The adoption of this scheme was also impracticable both on account of difficulties with peripheral speed, clearance, etc., and the fact that the amplification of harmonics of lower frequencies would be greater than that of the higher ones, resulting in distortion.

ELECTRO REPEATERS

These depend upon the emission of electrons from an incandescent body in a vacuum. It was shown by Dr. Lee de Forest in 1906 that this stream of electrons could be so controlled by the addition of other electrodes that a received current could be amplified by their means.

From this the three electrode "audion" or vacuum tube repeater element for use in telephony has been developed, principally in America, to the extent indicated in the introductory portion of this section. Time will not permit of the discussion of the theory of the 3-electrode vacuum tube repeater here, and I would refer those interested in the subject to the books and scientific papers listed in the bibliography appended to this paper. Briefly stated, the action is as follows:

If A (Fig. 9) be a vacuum tube having a filament F, raised to incandescence by current from a battery B1, and a grid G and plate P connected as shown, a current will flow from battery B2 between the plate and the filament. Then if a potential difference V be applied between the grid and the negative terminal of the filament, the field between

the plate and filament is altered and the current in the plate circuit is correspondingly altered. If the grid is positive with respect to the filament, the current in the plate circuit is increased. If it be made negative, the plate current is decreased, but no current flows in the grid circuit. It is found that if the plate voltage is altered the form of the curve representing the relation between grid voltage V and plate current I. (Fig. 10) is not altered but the magnitude of the current is changed, and that the current in the plate circuit may be altered either by altering the plate voltage, or by a much smaller alteration of the voltage applied to the grid circuit. The device thus gives a voltage amplification.

TELEPHONE REPEATERS IN PRACTICE

(1) In discussing the application of telephone repeaters to commercial telephony the following definitions should be kept in mind, and the distinction observed between the repeater element, the repeater circuit, and their combination, the repeater set.

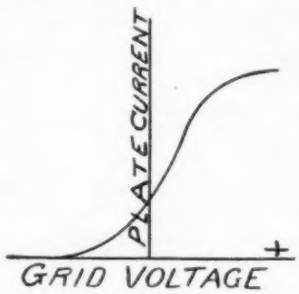


Fig. 10.

A telephone repeater set may be defined as equipment inserted at some point in the line for the purpose of amplifying voice currents transmitted in either direction over the circuit.

The repeater elements is that port of the equipment which receives, amplifies and retransmits telephone currents in one direction only.

The repeater circuit is that circuit arrangement which enables one or more repeater elements to give amplified transmission in both directions.

TYPES OF REPEATER ELEMENTS

(2) All repeater elements act on the principle of the control of a local source of energy. I propose to describe in a general way the operation of the two types which have been developed for commercial use and are now classed among the standard apparatus in regular use by the American Telephone & Telegraph Co. and its subsidiaries.

MECHANICAL REPEATER ELEMENT

This element, known as the No. 3a, is the latest development of the Shreeve receiver-transmitter type. Fig. 11 shows

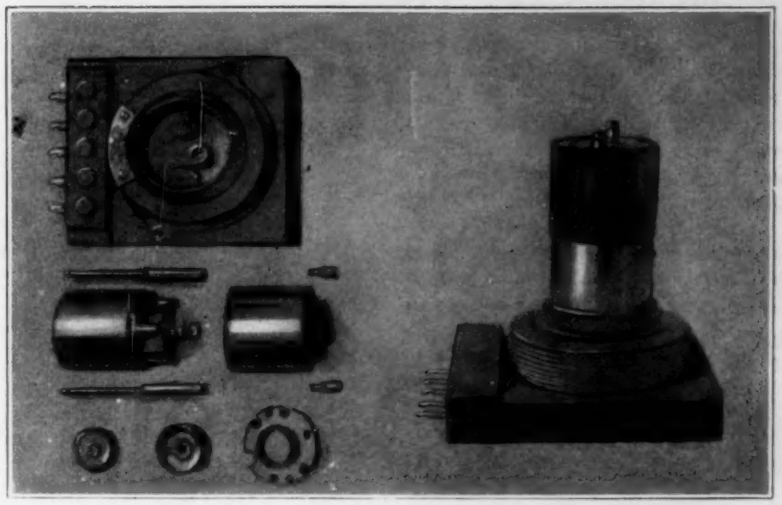


Fig. 11. Mechanical Type Telephone Repeater Element, Showing Socket Cartridge and Principal Parts.

the element, which is mounted in cartridge form, its principal parts, and the socket which permits of its ready insertion in or removal from the repeater circuit. Repeater sets using this element will produce under the most favorable conditions, an improvement in transmission of sixteen M.S.C. They can be satisfactorily operated "in tandem," that is to say, two or more sections of line, each having a repeater can be connected together. Two or more repeaters cannot be connected to the same line at the same office to give greater amplification as each repeater set requires for its operation a certain minimum length of line on each side of it. The first cost of this type of element is less than that of the vacuum tube type, and the power and maintenance costs are somewhat lower, but it is not so free from distortion and variability as the latter. Also, the inertia of the moving parts renders it less sensitive. Consequently its field of usefulness is restricted, and it has now been almost entirely superseded by the vacuum tube element.

VACUUM TUBE REPEATER ELEMENT

Fig. 12 shows a vacuum tube repeater element and the socket for holding it, and Fig. 13 an element with the glass bulb removed. The element consists of a glass vacuum bulb having three electrodes sealed in it, viz., a filament, plate and grid. When heated by an electric current the filament becomes a source of free electrons which travel in a continuous stream from filament to plate, under the action of an applied potential of about 130 volts. In the photograph the grid is shown between the filament and the plate. As indicated previously, as the number of electrons emitted by the filament, and therefore the plate current depend on the field strength at the filement, produced by the combined potentials of the plate and grid, changes of potential between grid and filament will produce corresponding changes in the plate current.

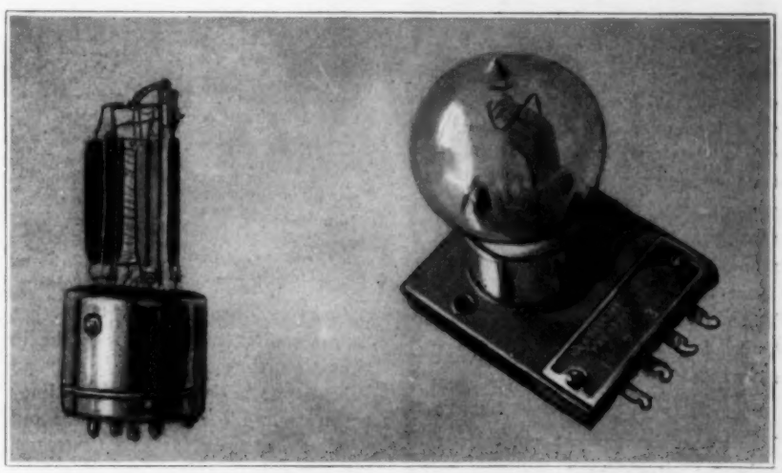


Fig. 12. Tube With Glass Bulb Cut Away.

Fig 13. Vacuum Repeater Element, Showing Tube in Socket.

As the moving parts concerned have infinitesimal inertia, the latter follows the former practically instantaneously, consequently the reproduction in the plate circuit of energy changes in the grid circuit is very close. Hence if the grid voltage be that due to speech waves, we can amplify these without appreciable distortion to any desired degree. Also, as the magnitude of these energy changes is proportional to the voltage variations on the grid, the latter voltage should be multiplied as much as possible before reaching the grid. For this purpose a step-up transformer is usually employed, having a ratio of 30 or 40 to 1. To transform the changes in the plate current into an alternating current the primary of another transformer is connected to the plate circuit, the secondary being connected to the outgoing line. Besides these, certain other apparatus must be associated with the element to produce a complete and efficient

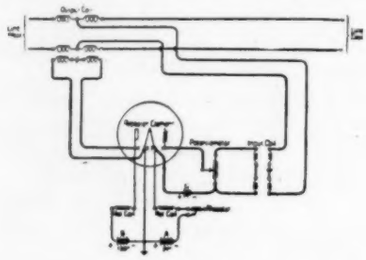


Fig. 14.

amplifying device for telephone work. These include retardation coils placed in the common battery circuit to prevent cross-talk between sets, resistances for regulating the filament current and some type of potentiometer for varying the amount of amplification. A small potential battery, C, must also be applied to the grid, but there is no current drain on this. The general relation of this apparatus is shown in Fig. 14.

REPEATER CIRCUITS — TRANSMISSION FEATURES

Several different methods have been proposed for obtaining transmission in both directions from single-way amplifiers, but that adopted as the basis of practical commercial repeater circuits is the Wheatstone bridge arangement. This arrangement, devised for preventing signalling in one direction from interfering with that in the opposite direction has been familiar to telegraph engineers, in its application to duplex telegraphy, for many years. The bridge circuit has taken several forms in telephone repeater practice.

THE "21-TYPE" REPEATER CIRCUIT

This was the earliest application of the bridge circuit to a two-way single element repeater. A simple arrangement is shown schematically in Fig. 15. The basis of this arrangement is a specially balanced output transformer. If this is properly proportioned to the impedances of the line, repeater input, and

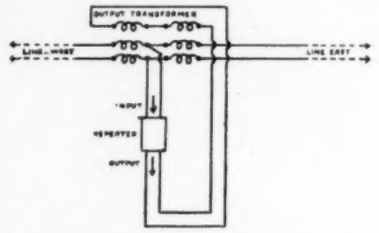


Fig. 15. Schematic of 21 Type of Telephone Repeaters Circuit.

repeater output, and the line impedances in each direction are identical, the single element will repeat in both directions without interference. The operation may be followed by tracing the currents in the "line west" to be repeated in the "line east." Current coming into the repeater from the west divides, part being transmitted from the west divides, part being transmitted directly to the line east unless the circuit is ideally proportioned, but the greater part is further divided between the output and input circuits. That flowing into the output circuit is dissipated, but the energy flowing into the input circuit is amplified by the repeater element and passes to the "output coil." At this point, if the lines east and west are similar in characteristics, half the energy goes east and half west. The latter serves no useful purpose, but the half going to the east is the desired amplified transmission which may be many times greater than the original amount arriving at the repeater from the sending end.

Referring to Fig. 14, the output transformer has two secondary windings with a tap at the exact center of each, to which the input coil of the grid transformer is connected. If now the im-

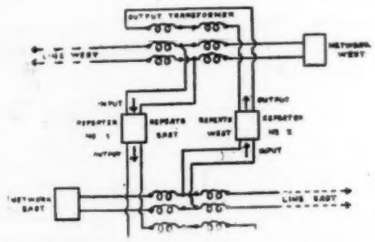


Fig. 16. Schematic Types of 22 Types of Telephone Repeaters Circuit.

pedance of "line east" balances that of "line west" at all frequencies the input circuit is the diagonal of a balanced Wheatstone bridge, whereof the line impedances and the halves of the output windings are the arms. Consequently current outgoing from the element sets up no P. D. across its input terminals. If the line impedances are unequal, even if only at certain frequencies, unbalanced potentials are produced at the terminals of the input circuits and re-amplified. If the amplification is sufficient to cause unbalanced potentials equal to and in phase with those originally set up, the process will be continuous, and "howling" will occur rendering the device useless as a telephone repeater. Hence the degree of amplification which can be introduced in any line is definitely limited by the degree of balance which can be maintained between the sections on either side. Other limitations of the 21-type circuit will be discussed in the description of the

22-TYPE REPEATER CIRCUIT.

This repeater circuit is that which has been most developed for commercial use.

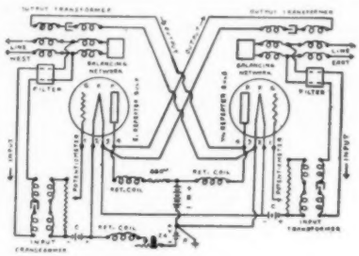


Fig. 17. Simplified Diagram of No. 22 Telephone Repeater Circuit.

It is a two-way, two-element circuit, and is shown schematically in Fig. 16. It is similar in principle to the 21-type, but has a separate repeater element for transmission in each direction, and the two Wheatstone bridge circuits it requires are made up by balancing each line by an artificial network, instead of by the other line. Its operation is briefly as follows:

Telephone currents incoming on "line west" divide, the output of repeater No. 1 is transmitted through the second transformer to "line east" and "network east." This network is designed to imitate very closely the impedance of "line east." If this imitation is exact, no unbalanced potentials are produced at the input of repeater No. 2. If, however, there is a difference in impedance, unbalanced potentials will be set up, amplified and fed back to "line west" and balancing network "west." If these are not identical in impedance, unbalanced potentials are produced, and return to the input terminals of repeater No. 1. Hence with this circuit the degree of amplification possible is limited by the degree of accuracy to which the impedances of each line and its corresponding network can be balanced.

Fig. 17 shows a simplified diagram of the 22-type circuit. It will be seen that telephone currents from line west pass

from the center points of the output transformer through a filter to the terminals of the input transformer, where their voltage is stepped up, and a portion thereof taken off by the potentiometer to the grid of the "east" repeater bulb, the amplifications produced in the plate current as previously described being fed through the output transformer to "line east." Similar process take place in the reception, amplification and transmission of telephone current from the east.

BALANCING NETWORKS AND FILTERS

From the foregoing it will be seen that the provision of accurately designed balancing networks is of vital importance if the maximum benefit from a repeater circuit of the type described is to be obtained. It has been found possible if the line is uniform in character, to design networks of a comparatively simple type to fulfil the requirements. On a non-uniform line, however, namely, one having a length of cable inserted in an open wire circuit, or having loading coils of varying inductance or inaccurate spacing, irregularities in the impedance characteristics of the line are produced and the difficulty of the problem is increased. Balancing networks consist of combinations of resistances, inductances and condensers, arranged to offer the desired impedance at telephonic frequencies. These have been reduced to very simple form for all commercial types of telephone line of uniform construction, but their proper determination for different types of circuits is still a matter requiring considerable care and experience.

The filter shown in the circuit diagram consists of an arrangement to permit the passage of periodic currents of frequencies within the range of normal speech currents, but to cut off those of frequencies above or below this range. By the use of the filter the difficulty of preventing singing on the 22-type circuit can be greatly simplified. Under the best conditions repeaters of the 22-type will give an improvement in volume equivalent to 18 to 20 M.S.C. at 200 p.p.s. On long circuits several repeaters may be used in tandem at properly spaced intervals. It has been found in practice, that on long tandem circuits it is preferable to obtain moderate amplifications at a number of points rather than to attempt maximum amplification at a few points. The improvement on such a circuit cannot in general exceed 75 percent of the total attenuation of the line.

COMPARISON OF THE 21 AND 22-TYPE CIRCUITS

The following are the relative advantage of the 21 and 22-type repeater circuits. The former takes about half the space, apparatus, and power required by the latter, does not require balancing equipment, and has the minimum initial and maintenance cost, but will operate satisfactorily only between lines of similar character. The 22-type circuit can be employed between lines of widely different characteristics, so long as each line is provided with a suitable balancing network. The 21-type must be equi-distance from the ends of a trunk line, as otherwise the terminal apparatus will affect the impedance at the repeater station to a greater extent in one direction than in the other, limiting the amplification by increasing the difficulty of balancing.

Other disadvantages of the 21-type have to be considered when the future expansion of the telephone plant and possible extensions in the use of repeaters are taken into account. It is not suitable for tandem operation, as part of the amplification is sent back to the origin, and if the attenuation between repeating stations is nearly compensated for by the repeater, an echoing effect will result, seriously affecting the quality of transmission. Where unbalance between two lines is present as is always the case in practice, the 21-type will give more gain in one direction than the other. The 22-type is inherently more stable and to be preferred for general application.

Another development in repeater practice which is rapidly approaching the commercial stage is the four-wire transmission circuit.

THE FOUR-WIRE REPEATER CIRCUIT

In this method the circuit consists of four conductors instead of two, one pair being used for transmission in one direction and the second pair for transmission in the other. A circuit of this type is shown diagrammatically in Fig. 18. Evidently in such an arrangement, as only one-way repeaters are needed, balancing difficulties are almost entirely eliminated, and the repeaters may introduce sufficient amplification to annul the entire attenuation in the four-conductor portion of the circuit. Moreover, the gain permissible at each station may be from 20 to 30 M.S.C., the only limitations being possibility of cross-talk and external disturbance. It should be noted that the term "four-wire" does not necessarily imply that four wires are used, but that different circuits are used for transmission east and transmission west. Each of these may be a pair of wires, or a phantom circuit, etc. At the ends of the four-wire circuit the two branches have to be brought together for connection to twi-wire lines, and at these points balancing networks are introduced to minimize the effect of circulating currents which may be set up and flow over the two sides of the circuit in series. It should be noted that although this current uses twice as many conductors as the ordinary circuits, it permits the use of smaller wires. For long-distance cable operation and special cases they have been found economically appliacble.

OPERATING FEATURES OF TELEPHONE REPEATERS

Two general types of repeater equipment have been devised to either of which the mechanical or vacuum tube element is applicable, and are known as the "cord circuit repeater" and "through line repeater." This latter is inserted permanently in a long trunk line to improve the transmission efficiency. The former is used to connect trunk lines together in building up long-distance connections where there is insufficient traffic to warrant a direct circuit, or when the direct connections are already engaged.

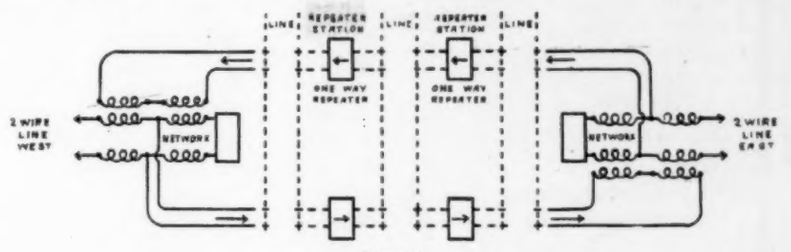


Fig. 18.

The cord circuit repeater forms part of a cord circuit equipment under the control of an operator. The circuit terminates in two double plugs on the operator's position so that she can connect together any two lines terminating in the toll line multiple in front of her which are equipped for repeater operation.

Such lines are provided with two jacks, one connected to the line itself and the other to its corresponding balancing network. The amplification given by the repeater is under the operator's control, and is regulated by a potentiometer which may be set in different positions by four relays; these relays being governed by a special four-position sliding key in the key shelf of the position. The first position of the key connects the repeater into the cord circuit

and closes the "A" battery-filament circuit. It also connects the repeater to the line, giving comparatively low amplification, which may be increased by successive steps of the key.

The through line repeater is permanently associated with a particular toll line, which does not terminate at the repeater office. It is in circuit at all times so that its power consumption is much greater than that of the cord circuit type. Through signalling is obtained by means of relays which temporarily remove the repeater from the circuit. Through repeaters may be equipped for 16 2/3 or 135 cycle ringing current, depending on the ringing efficiency of the repeating coils on the toll line and the type of apparatus to be operated at the terminal offices. Both cord circuit and through repeaters may be assembled on one of two types of mounting, the Unit type or the Relay Rack type. The Unit type mounts one cord circuit or two through-line repeaters, takes up one square foot of floor space and is 6 feet in height. The Relay Rack type of mounting is more economical of space where a number of repeaters are to be installed in one room.

POWER PLANT REQUIREMENTS

As indicated in the circuit diagrams, three sources of electric power are required for vacuum tube repeaters, viz., (1) the storage battery of 24 or 48 volts for the supply of current to the filaments, (2) that for the plate current at 130 volts, (3) that for maintaining potential on the grid. The last is usually composed of sufficient dry cells to give a potential of about nine volts. Not being subjected to any current drain this battery requires renewal only when it has deteriorated with age. "A" current is supplied by the regular 24 or 48 voltage exchange battery if this has sufficient reserve capacity, but a duplicate set is advisable to avoid operating the repeaters from a battery while it is being charged. The filament current should be kept within specified limits as the amount of current has an important bearing on the life of the vacuum tubes. The current consumption per through-line repeater is about 33 amp. hours in 24 hours at 24V. The consumption of a cord circuit repeater depends of course on the time it is in actual service.

For the "B" battery a separate charging equipment and storage battery are installed, the voltage being 130 for maximum gain and 120 for moderate gain. If the negative terminal of the "A" battery is earthed these figures must be increased by about 15 volts.

MAINTENANCE

The cost of maintenance of repeater installations is small. The average life of a vacuum tube is about 1,500 working hours, provided it is not worked with a too heavy filament current.

RELATION OF REPEATERS TO THE TELEPHONE PLANT

(1) *Phantomed and Composite Lines.*—In the foregoing, the repeater has been considered only as associated with simple lines. It may, however, be used on any of the usual types of super-imposed or combined telephone and telegraph circuits. Both loaded and non-loaded phantomed aerial and cable circuits may use repeaters both on the physical and phantom circuits.

(2) *Importance of Uniform Line Impedance.*—From the discussion of the action of repeater circuits in the preceding pages the importance of uniformity and impedance in the line and particularly the essential feature that this impedance shall not vary irregularly with frequency, is manifest. Various irregularities in the line make the curve connecting variations of frequency with impedance irregular, and consequently in some cases it is difficult or practically impossible to produce an artificial network to stimulate the line characteristics.

Equipment at intermediate points, such as cord circuits, bridge stations, phantom coils, etc., will introduce irregularities and should be eliminated where practicable. Short lengths of cable in open wire lines and in loaded lines introduce impedance irregularities, and it may be said that in general a circuit on which repeaters are to be used should be made up as uniformly as possible throughout its entire length.

Loaded lines are much more subject to differences in their impedance characteristics than non-loaded lines, owing to inaccuracy in spacing and differences in the inductance of the loading coils. The introduction of repeaters has necessitated research in the improvement of loading coils, the older type of coil being found unsatisfactory when repeaters are used, being subject to magnetization from lightning and other causes. The changes in inductance resulting from this magnetization result in non-uniformity of impedance in the line circuit. To overcome this defect several new types of repeating coil have been devised, possessing the necessary stability. The new coils constitute a considerable advance in loading practice, the basis of the improvements being the use of material for the cores having high magnetic stability and low losses, and a different cort structure from that used in the older type coils. Accurately uniform spacing of loading coils in circuits using repeaters is much more important than on ordinary circuits, it having been found necessary to reduce the former allowance of 5 percent variation from the theoretical loading point to 2 percent. The practical problems arising from the necessity of securing uniform impedance characteristics of lines and networks at different frequencies has led to the development of a range of apparatus for measuring impedance rapidly and accurately in the field, and also for the determination of transmission efficiencies over the whole range of normal telephone frequencies. The use of repeaters has simplified the problem of maintaining satisfactory standards of transmission on long-distance service, and it is now considered that the total transmission loss between subscriber and subscriber on any connection should not exceed 30 miles M. S.C. This reduces the maximum toll line allowance between the test-boards to twelve miles M.S.C.

TRANSCONTINENTAL LINE

In the earlier part of this paper the New York-Denver circuit was described and the circuit shown schematically in Fig. 2 as it existed in 1911.

A striking result of the application of repeaters is the extension of this circuit to San Francisco opened in 1915 and the reduction of the total transmission equivalent over the 3,400 miles between New York and the Pacific coast to 21 miles of standard cable. Fig. 19 shows this circuit set up for through connection.

It will be noted that provision is made for three simultaneous telephone conversations, and also eight telegraph messages, a remarkable development in a short period.

ECONOMIC CONSIDERATIONS

In order that a telephone system be satisfactory, viewed from the economic standpoint, it must involve the minimum possible annual expenditure over a term of years. This result can only be obtained if the different parts of the system are designed to be in "cost equillibrium." This principle was crudely stated in the section in the first part of this paper dealing with the influence of transmission problems on the design of minor apparatus in telephone exchanges. It means that each part of the equipment should be designed as far as possible to perform its work at an annual cost not radically different in percentage of capital expenditure from that of any other part.

The cases in which the question arises whether the use of repeaters will be economically justified may be divided into two broad classes:

(1) Where it is proposed to improve the quality of transmission in an existing installation for the purpose of (a) extending the range of satisfactory service, or (b) increasing the traffic by providing improved facilities.

In this case it would have to be determined whether the desired improvement might be obtained on the basis of minimum annual charges over a given number of years by installing repeaters, by loading if the circuits are not already loaded, or by replacing the circuits under consideration by new ones of heavier gauge and using the existing circuits for other service. The possible necessity of modifying the line to permit of repeaters being used would have, naturally, to be taken into account.

(2) In the design of a new lay-out. This is a somewhat simpler case, as it is easier to provide the most economical scheme as the choice of methods is less restricted. A great number of considerations are involved, however, such as the number of circuits required at the beginning, and for a number of years thereafter, as it may be more economical to install circuits which will be idle for a time than to make additions in the near future. The grade of tansmission to be provided must be decided on. The length of line is of great importance, as a scheme which would be economical for a short distance service is often not the most economical for a longer line. Having obtained as accurate details as possible for these and other factors to be included in the study, the probable annual charges on the system, if constructed in any one of several possible ways, must be estimated from experience with similar apparatus under similar conditions. A simple example of such a study is the following:

It is desired to build a line 150 miles long having 150 circuits, the transmission equivalent between test-boards to be 12-14 miles M.S.C. The desired conditions can be obtained by:

(1) An open wire line of No. 12 S. W.G. copper, this having approximately the transmission equivalent specified.

(2) A heavy-loaded No. 16 A.W.G. cable with two-way repeaters near the middle of the cable.

(3) Two heavy-loaded No. 13 A.W.G. cables. (*Note*—Two cables would be necessary, as a quadded cable of this size conductor for the total number of circuits would not be economical.)

Of these (3) would probably be slightly more expensive than (1) on an annual charge basis, and either would be about 60 percent more expensive than (2). Suppose, however, that only one-third of the facilities are required immediately, one-third after 5 years, and the remainder after 10 years, or that about half are sufficient for the first 7 years. Then the open-wire system could be economically installed as required, the second of the No. 13 gauge cables could be laid when necessary, probably at the end of 7 years, while the No. 16 gauge cable could be installed at once, but only those loading coils and repeaters provided that would be needed at once, other being added when necessary. In these circumstances, there would be much less difference between the three plans, but the open-wire line would still be 20 percent more expensive than the 16 gauge cable, while the 13 gauge cables might be about 45 percent more expensive. An actual case would, of course, be worked out with far greater precision, based on traffic studies, known costs, probable life of apparatus, etc., this example merely indicating the range of possibilities, and being intended to show roughly the degree of economy that may be obtained under certain conditions by the use of repeaters.

I have endeavored in the foregoing to fulfill the promise given in the opening paragraph of this paper, namely, to present, briefly and clearly, consistent with the extent of the subject, an outline of developments in telephone transmission.

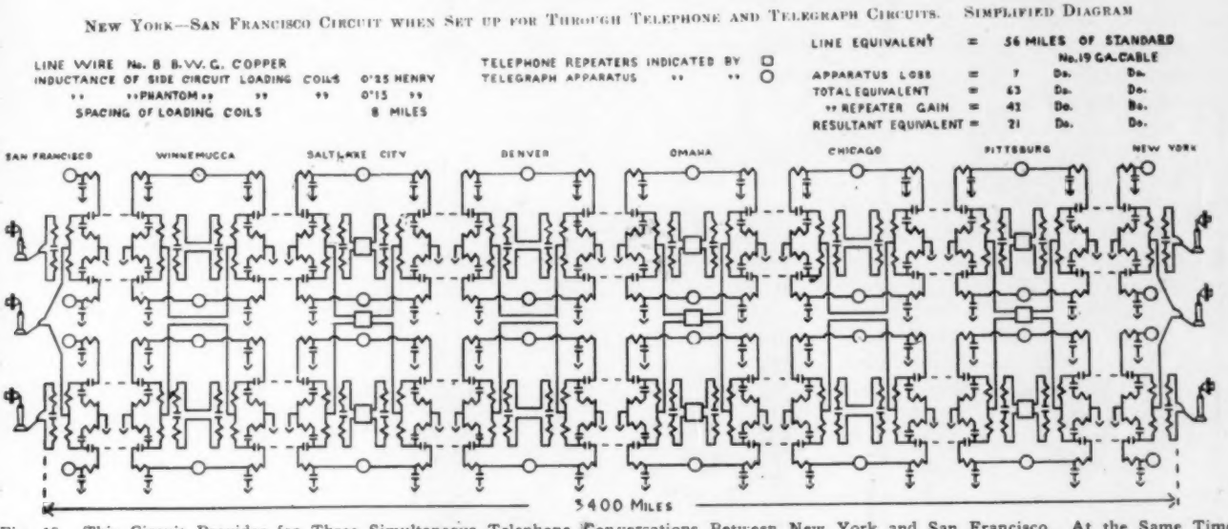

NEW YORK—SAN FRANCISCO CIRCUIT WHEN SET UP FOR THROUGH TELEPHONE AND TELEGRAPH CIRCUITS. SIMPLIFIED DIAGRAM
LINE WIRE No. 8 B.W.G. COPPER
INDUCTANCE OF SIDE CIRCUIT LOADING COILS 0·25 HENRY
" "PHANTOM " " " 0·13 "
SPACING OF LOADING COILS 8 MILES
TELEPHONE REPEATERS INDICATED BY □
TELEGRAPH APPARATUS " " ○
LINE EQUIVALENT = 56 MILES OF STANDARD No.19 GA. CABLE
APPARATUS LOSS = 7 Do. Do.
TOTAL EQUIVALENT = 63 Do. Do.
" REPEATER GAIN = 42 Do. Do.
RESULTANT EQUIVALENT = 21 Do. Do.
SAN FRANCISCO
WINNEMUCCA
SALT LAKE CITY
DENVER
OMAHA
CHICAGO
PITTSBURG
NEW YORK
3400 MILES

Fig. 19. This Circuit Provides for Three Simultaneous Telephone Conversations Between New York and San Francisco. At the Same Time It Provides for Four Telegraph Messages in Each Direction.

In the nature of the case the presentation must be more or less imperfect, and some of the details mentioned as novel way have become ancient history in a very short time. If, however, the paper proves to be of help in the closer study of the subject, and the origin of interesting and valuable discussion, it will have amply served its purpose.

I have to express my indebtedness to the Western Electric Company for much of the information in this paper and for permission to use drawings and photographs; to Messrs. Gherardi and Jewett for permission to make use of details and illustrations given in their paper "Telephone Repeaters"; to the numerous contributors to the literature of the subject, references to whose works are scattered throughout the paper and are included in the bibliography; and particularly to H. P. Trainor and Capt. R. T. McArthur (of the engineering department of the Union Postoffice) for valuable assistance in its preparation.

Well, Then!

At ten o'clock in the morning he had tried to call up his wife on the phone. At noon he tried again. And then the operator said impatiently: "I told you two hours ago that she was talking, didn't I?"—American Legion Weekly.

Minnesota Convention Admits Bell Companies

At Annual Meeting in St. Paul on January 25-27—By-laws Changed Making All Operating Telephone Companies Eligible to Membership

THE twentieth annual convention of the Minnesota Independent Telephone Association was held at St. Paul on January 25-27. The name of the association was changed to Minnesota Telephone Association, which will allow all operating companies in the state to become members. This move will widen the scope of the association activities.

More than two hundred delegates were present at the meeting and great interest was taken in the sessions, which were devoted to practical telephone problems. Under the bylaws of the new association the board of directors elect the officers, so the convention elected the following directors: H. F. Louders, Norwood; Thomas Vollom, Erskine; E. P. Wright, Alexandria; G. W. Gretorex, Blue Earth; Jay Graves, Glencoe; P. M. Ferguson, Mankato; W. S. Clay, Hutchinson; Irving Todd, Hastings; D. M. Neill, Red Wing, and F. D. Lindquist, Fulda.

D. M. Neill, of Red Wing, made the opening address and outlined the many important matters to be discussed and acted upon by the delegates. Mr. Neill was followed by H. F. Louders, president of the association, who talked about the work done during the past year. Thomas Vollom spoke on the development of small exchanges and pointed out the necessity of co-operation. He touched on many of the problems of small operating companies and made many suggestions along the line of modern service and practice. He dwelt particularly on the need of understanding between the company and the public. Mr. Vollom's address was followed by a general discussion of the subject, but particularizing on rates, after which President Louders appointed the following committees:

Bylaws: Senator James A. Carley, of Plainview; D. W. Gretorex, of Blue Earth; D. M. Neill, of Red Wing; Jay Greaves, of Glencoe; and Secretary E. C. Kast.

Resolutions Committee: D. M. Neill, of Red Wing; S. M. Smallwood, Worthington; Senator James A. Carley, of Plainview; Jay Greaves, of Glencoe; and E. P. Wright, of Alexandria.

Auditing Committee: A. C. Buck, of Arlington; Harry Kurz, of Annandale; and Levi Johnson, of Watertown.

Legislative Committee: W. S. Clay, of Hutchinson; A. W. Ewing, of Madison; P. M. Ferguson, of Mankato; F. D. Lindquist, of Fulda; D. M. Neill, of Red Wing; Thomas Vollom, of Erskine; James A. Carley, of Plainview; Jay Greaves, of Glencoe; D. W. Gretorex, of Blue Earth; Charles Knapp, of Big Lake; H. F. Louders, of Norwood; I. Todd, of Hastings; and E. P. Wright, of Alexandria.

The convention on vote then adjourned for the day.

SECOND DAY'S SESSION.

In the absence of the president, D. M. Neill presided at the opening of the second day's session. P. M. Ferguson, of Mankato, was introduced and read a paper on plant accounting. Mr. Ferguson was followed by a general discussion of traffic problems, in which discussion Jay Greaves, of Glencoe, spoke at some length. He called the delegates' attention to the following rules which are posted in the exchanges of his company:

H. F. LOUDERS.
President Minnesota Telephone Association.

Operators are requested to familiarize themselves with the following topics and will be expected to observe both the letter and the spirit of the rules to the fullest extent:

1. Quiet and order in the operating room:

Quiet and order should prevail in the operating room at all times. Loud talking, laughing, etc., should be guarded against. This is especially important when a new shift comes on and the operators at the board are being relieved.

2. Visiting over the lines:

It is strictly against the rules for operators on duty to visit over the lines.

3. Company:

Company should not be entertained in the operating room by operators while on duty.

4. Attention to Work:

Reading, writing, sewing, etc., are not to be done by operators while on duty.

5. Routine of Answering Calls:

Calls on the local board should be answered with "Number, please?" and on the farmer board by "Glencoe." The number should be repeated to the party calling. See how little you can use the word "Hello."

6. Care of Switchboard, etc.:

Operators should guard against scratching, marking, or mutilating the switchboard in any way. Do not unnecessarily handle keys, plugs, etc. So far as possible, remove plugs by taking hold of plug—not cord.

7. Courtesy:

Too much importance cannot be given to this topic. Tone of voice counts for everything. Never lose your temper. Never talk back to a subscriber. Cultivate a kindly spirit, especially toward the operators in other towns.

8. Attention to the Switchboard:

All positions at the board should be filled according to schedule. When three operators are on duty, two should not be doing the work with one away from the board. Watch all connections closely. Keep your mind on your work.

9. Co-operation at the Board:

It is the duty of each operator to assist the operators at the other positions as much as she is able. Co-operation and teamwork are desired.

10. Emergency.

In all cases of emergency calls such as fire, police, etc., keep cool. Think out in your own mind so far as possible, what to do in such cases. Know how to use the Pyrene fire extinguisher.

11. Tri-State Board:

It is the duty of the operators of the McLeod County Telephone Co. to care for the Tri-State board when the Tri-State operators are not on duty. Never say that it is not your business to care for the Tri-State board.

12. Doctor Calls:

When a doctor is called, never connect with or suggest another doctor if the one called does not answer. Do all you can to locate the doctor called. If this cannnot be done, let party calling say who he wants. In cases of emergency, accidents, etc., use your best judgment:

call any one whom you can get quickly.

13. Connection with the Manager:

Never refuse anyone connection with the manager when he can be found.

14. Electric Lights:

Lights should be switched off when their use is not necessary. This applies especially to light in bedroom. The first operator to leave at night should turn off light in hall.

15. Street Door:

On entering or leaving the building, operators should always leave front door locked when they find it locked.

In the exchanges of the McLeod County Telephone Co. time-of-day and other information is given out so long as too much extra traffic is not involved.

Mr. Greaves' remarks was followed by a general discussion of his subject in which many of the delegates participated.

P. M. Ferguson and T. C. Macoubrey then opened a discussion on plant accounting which was fallowed by an address of Charles C. Deering of Des Moines, Iowa, secretary-treasurer of the United States Independent Telephone Association, by F. B. MacKinnon, president of the United States association, was unable to attend the convention. Mr. Deering discussed Iowa conditions and stated that Iowa telephone men are not asking for anything in the legislature this year and desire to be left alone.

Mr. Deering closed his address with the declaration that some companies under these changed conditions feel that there is less need of associated effort. This is a mistake for the need is just as great as ever.

R. L. Parker of Traer, Iowa, president of the Iowa Independent Telephone Association was next called upon and declared that telephone men are specially blessed in Iowa. There is practically no regulation by city councils as to rates and the company are independent as to state regulation. They have appreciated the value of publicity and are close to the local newspapers.

"We may have regulation forced upon us," declared Mr. Parker, "but we are not asking for it."

Senator James A. Carley of Plainview spoke upon the subject: "The Legislature." He stated that bills are introduced by scores in which only one locality is interested, and bills are also introduced by the scores to remedy bills previously passed.

After Senator Carley's talk Thomas Vollom moved the appointment of a committee of three to confer with the Tri-State and Northwetsern Bell in the interests of co-operation. Thomas Vollom, A. C. Buck and Levi Johnson were named.

G. W. Robinson, president of the Tri-State company, talker on the matter of the Interstate Commerce Commission's fixing depreciation. He advised the commission is moving slowly and will take the matter up at some length with the various telephone companies before anything is done.

The following resolutions were then read and adopted:

"Whereas, The attitude of the public toward the telephone industry has become so acute as to shake the stability of the business, and threatens to throw it into chaos, in which case the public will be the greatest sufferer, and

"Whereas, We believe this condition arises largely from a misapprehension of the difficulties and expenditures incident to the furnishing of adequate telephone service, and we ask that the public advise itself by a study of our yearly reports, made under oath and filed with the Minnesota Railroad and Warehouse Commission, and compare the result with that of any industry in the state as to the returns on capital invested and economy of management. No industry in the state during these years of stress has given so much and received so small a compensation, and the time has come when the public must accord the telephone companies a fair return or suffer a great decline in quality and amount of service than any experienced heretofore;

"Therefore, Be It Resolved, That we indorse the action of the Tri-State Telephone & Telegraph Co. and the Northwestern Bell Telephone Co., in submitting to the Minnesota Railroad and Warehouse Commission an inventory showing their valuation of their respective and expenditures in detail, and asking that a sufficient revenue be allowed them to meet the cost of service and depreciation, and allow a fair return on the capital invested, and

"Be it further resolved, That we ask from the railroad and warehouse commission a fair consideration and early settlement of these cases on their merits as being in the best interest of the public and of the industry at large, irrespective of popular clamor or the vaporings of irresponsible demagogues.

"Upon motion, a committee of three was appointed to present the resolution to the commission in person."

This concluded the second day's business session. In the evening a dinner and theater party was tendered the delegates provided by the entertainment committee, composed of S. D. Harris, Jay Houghteling and E. R. Smith.

THE THIRD DAY'S SESSION

The last day's session opened with a general discussion legislation for protection of telephone lines from high tension power lines. The discussion was led by P. M. Ferguson, B. C. Hazle and D. W. Gretorex.

The report on changing the association's name and scope was then called for by President Louders. D. W. Gretorex presented the report which he stated incorporated all points which seemed desirable to cover. He then read the bylaws of the new association:

Article 1. The name of the association shall be the Minnesota Telephone Association.

Art. 2. The object for which it is formed is to aid the telephone industry; to furnish to its members information and advice upon all subjects relating to telephony; to assist in securing uniform standards of telephone operation, accounting and practice; to aid in establishing and maintaining a high grade telephone service for the public and to assist in educating the public, not only to an appreciation of good service, but to a recognition of the necessity of providing adequate compensation to secure a continuation of such service; to authorize the association's officers or committees to represent the telephone interests before regulatory and legislative bodies.

The new bylaws specify that the membership shall be divided into three classes, active, associate and honorary. "Active members shall be bona fide operating telephone companies, at least, a part of whose operations are within the limits of the state of Minnesota. Associate members shall be manufacturers of or dealers in telephone equipment or supplies."

After a general discussion of the matter the new bylaws were unanimously adopted.

D. W. Gretorex then moved the incorporation of the association, with instructions to the board of directors to carry it out. This motion was seconded and carried.

Mr. Gretorex then moved that the convention proceed to the election of directors, as provided in the new by-laws and the motion when put, was carried.

President Louders then called for the report of the nominating committee.

It was moved and seconded that the secretary cast the vote of the association for directors as named by the nominating committee, and this was carried unanimously.

The resolution committee then presented resolutions on the deaths of E. B. Fisher and James M. Moore as well as the usual resolution to the committee's officers, hotel, entertainment committee, etc., after which Lucius F. Clark of Bellingham, read a paper on "Association Opportunities, Past, Present and Future." Jay Houghteling then made a brief address on "Buying" and after some routine business the convention adjourned.

As alum to the mouth, as a pebble in the shoe, so is a woman who telephoneth thee overmuch.

The Telephone Situation Today

New Developments in Raw Material, Apparatus and Supplies Brought About by Present Day Conditions

By W. N. FURTHMAN.

DUE to the high increase in the cost of hard rubber, it has been the practice for the last ten years to use what is known as a hard rubber substitute in the manufacture and assembly of transmitters, receivers, plug shells and key shells. This substitute for hard rubber consisted in a large part of a composition of scrap rubber treated with a sulphur and asphaltum process. One of the principal difficulties in the use of this composition was found in the milling operation of the various parts and it was also noted that its durability under ordinary wear and tear was not as satisfactory as the hard rubber. During the past two years great progress has been made in the use of molded bakelite. This bakelite has been found to be a very satisfactory substitute for hard rubber, particularly in receiver shells and transmitter mouthpieces. The use of bakelite has brought about not only a considerable saving over hard rubber, but has also brought about a material reduction in the cost of parts in which it has been substituted for composition hard rubber. As an insulator bakelite does not have the high surface insulation resistance of hard rubber, but is entirely satisfactory in this respect for telephonic purposes.

PORCELAIN INSULATORS

It has always been the practice to use pony glass insulators in telephone pole construction. For a good many years, however, it has been the practice in high powered circuits to use porcelain insulators has been found to be the only means of obtaining good insulation resistance on high powered circuits. In the construction of the Boston-San Francisco loaded circuit it was positively determined that even with the use of loading coils and repeaters this circuit would be an entire failure with the use of pony glass insulators. Tests on this circuit have shown conclusively that it was necessary to design a petticoated porcelain insulator for the entire overhead wire equipment of this circuit. It has also been determined that the use of such an insulator brings up the efficiency of either a metallic or grounded circuit to such a point that it may be safely said that nearly all of the difficulties which have been found due to electro-static and electro-magnetic induction are overcome when the circuit is equipped with insulators of this kind.

COPPER CLAD WIRE

A large number of transmission tests have been made in connection with the use of a copper clad steel wire. Transmission losses which are found in making tests on this wire as compared with solid copper wire show that the solid copper wire is, of course, higher in conductance than the copper clad steel wire. During the war, however, the shortage of copper wire brought about necessarily, in many cases, the use of copper clad steel wire. Due to the necessity of its use in practice it has been found that while its conductance is lower than that of copper wire, it can be safely substituted for copper wire, provided the insulation resistance of the line on which it is to be used is brought up to its proper efficiency. In other words, it has been demonstrated that a copper wire circuit with poor insulation resistance is lower in efficiency than the copper clad steel wire circuit that is high in insulation resistance.

FLAME-PROOF WIRE

During the war the demand for flame-proof wire in connection with the use of the telephone in the trenches became so urgent that material progress has been made not only in the manufacture of this very necessary product, but also in the production of a more efficient flame-proof wire. There are quite a number of so-called flame-proof wires now on the market, a majority of which, however, do not fulfill all of the requirements of the underwriters' specifications. While there are a good many wires that will stand up under a heating test, there are very few that have been sufficiently developed to withstand what is known as a burning or flame test. One of the principal difficulties in obtaining a flame-proof wire is brought about by the necessity of using two colors in the manufacture of flame-proof wire for telephone purposes. The use of dyes in the colors of such wires adds materially to the problem involved in obtaining a satisfactory wire. It has been found that while some processes will bring about a satisfactory flame-proof wire, they also cause injury to the insulation of the wire due to the minerals which are used in the dyes. Laboratory tests have shown that high insulation resistance in a flame-proof wire with the proper dyes can only be obtained by treating such wires with wolframite or tungsten impregnating process.

For a good many years it has been the problem of telephone engineers to develop a satisfactory rectifier which can be used in place of the standard motor generator now used for the purpose of charging storage batteries. It has always been self-evident that if current could be obtained from the power companies and properly rectified for charging batteries, a material saving would be effected in its use. On considering the design of a rectifier, it has always been the plan, if possible, to use a motor of not more than one-quarter horsepower, which can be safely equipped with a mechanical rectifier which would give a pulsating charging current which would be almost equivalent to the direct line obtained from a motor-generator set. This problem has been difficult of solution due to the variation in the load factor of the power companies, which necessarily brings about a material difference in the speed of the motor and therefore affects any design of mechanical rectifier driven by the shaft of such a motor. Many efforts have been made to obtain a synchronous motor which would maintain its status under all of the variations in the load factor of a commercial power circuit. Up to the present time it has been impossible to obtain such a synchronous motor which would bring about a saving in its use as compared with the standard motor generator set. By means of the governor which operates on the end of the shaft of the motor beyond the mechanical rectifying device, it has finally been possible to obtain a rectifier which meets all requirements. The substitution of such a rectifier for the standard motor-generator set should therefore result not only in material operating saving from first costs, but also from a charging standpoint.

TRANSMISSION TESTS WITH THE BARRETTER

In making transmission tests not only in the laboratory but also in the field, it has been the custom to make such tests in comparison with the standard which has been calibrated in miles of cable. In making such tests only the ear has been used for checking one standard against the circuit under test. This introduction of the human element has brought about many discussions where new devices have been accepted or rejected on the result of such tests. While it is possible for an expert to become accustomed to the accuracy required in making such tests, the

fact that such an important factor in the efficiency of a telephone circuit has not finally been brought down to the use of a sensitive instrument has always left the way open for a question in the results of such tests, especially where it has been decided that there was or was not a difference of four to five miles of transmission loss determined in comparison of one transmitter against another or receiver or repeating coil as compared to the standard product. It has always been evident that it would be impractical to take into the operating field an instrument which was so sensitive that it could only operate in making such delicate tests under laboratory conditions.

A Barretter has recently been developed which depends entirely for its successful operation on the use of two standard switchboard lamps, with or without a vacuum in the bulb, which must be equal in resistance capacity and inductance. The development of audion bulbs has now been brought down to that point where the use of satisfactory Barretter lamps may be readily obtained, so that the successful use of a Barretter is now a fact **not only** in the laboratory but also in making transmission tests in the field.

CROSS-TALK IN BATTERY LEADS

The use of the Barretter in the field has brought about the interesting conclusion that a large amount of disturbance in a metallic telephone circuit which has heretofore been laid to electro-static and electro-magnetic induction can be traced to the difference in length of leads which are used in connection with the telephone storage battery. While the battery leads which have been specified as standard for this purpose are large in size, it has been determined beyond question that this difference in length which brought about the difference of resistance, capacity and inductance in the telephone circuit **was** responsible for a material amount of disturbance which has been found on ordinary metallic circuits.

In further connection with the use of a Barretter in the field it has also been found that the standard practice of assembling ringing leads from the generator in the keyboard circuit has also been responsible for a large amount of inductive disturbances which heretofore were thought to have been brought about by adjacent power circuits of high voltage. Also by means of the Barretter it has been determined that the transmission loss of the torroidal repeating coil is not lower than the other types of repeating coil which are on the market and which have been in use for a number of years. It has, however, been determined that such repeating coils are higher in cross-talk than the torroidal type of repeating coil. This difference in cross-talk efficiency is due to the fact that in the torroidal coil the losses due to the iron core and metal case surrounding the coil are lower than in any other form. It has also been determined that the use of twisted wires in the primary winding add materially to this efficiency where the difference in such twisted wires is balanced for resistance, inductance and capacity. The writer has determined by means of a Barretter and a special alloy wire that it is possible to manufacture the torroidal type of repeating coil which will have absolutely no cross-talk. When it is understood that such a coil can be produced at the same cost as standard coils now on the market and that a Barretter has shown that this reduction of cross-talk has not caused a loss in transmission, it will be apparent that the use of such equipment should bring about a material increase in transmission, not only of metallic but also of grounded circuits.

Rural Exchanges Will Be Reclassified

The Pennsylvania Industrial Board has adopted a tentative ruling reclassifying rural telephone exchanges where a private home is used as the exchange, Commission Connelly, of the Department of Labor and Industry, announced recently.

All rural exchanges are now classed as "establishments" so as to come under the provisions of the woman's law affecting the hours of employment of female operators.

The new ruling will be effective upon final approval by the board at its regular meeting in March.

The regulation affects those exchanges in a rural community where the operator is a member of the family in which the exchange is located. She must be given at least six hours' rest during the night period.

At the present time this kind of exchange is not subject to regulation so that the operator, who is usually a member of the family, may be called at all hours of the day or night.

The telephone companies will not evade the law by putting an exchange into the "home" class under the provisions of this ruling. The existence of a sleeping couch in an ordinary exchange does not bring it under these provisions making exceptions for such operators.

The woman's law applies where the operator reports for definite hours, when she must leave her home and where night service is such that no definite hours are necessary, it was explained. This applies whether the operator is a member of the family or otherwise.

Ohio Convention, March 16-17, at Columbus

The twenty-sixth annual convention of the Ohio Indepednent Telephone Association, will be held at the Hartman Hotel, Columbus, on Wednesday and Thursday, March 16 and 17. President Frank L. Beam is looking forward to the biggest convention the association has ever held, and urges all telephone men to make arrangements to be present during the two-day meet.

Asks a Separate Telephone Department in California

C. A. Rolfe, executive officer of the Southwestern Home Telephone Co. at Redlands, Calif., appeared before the Railroad Commission investigation committee in Los Angeles recently and was one of those asked to give his impressions of the work of the commission to the committee.

"The investigation of the Railroad Commission by the committee of State Legislature, from my observations during the session of the commmittee, was doubly beneficial," said Mr. Rolfe. "I gave the people a chance to state their troubles and it showed the commission as well as the committee how some of the people viewed the commission's acts. Most of the complaints were the result of misunderstandings on the part of the public and no ways to be blamed on the Railroad Commission.

"I made a statement to the committee that the telephone people did not want to criticize the commission, fully realizing the immense work it was doing, but wished to call attention to delaying in handling telephone application and complaints which were very expensive to the companies. I asked for reorganization of the engineering force of the commission and that the great telephone industry have a department separate and individual and that it be not required, in the future as in the past to depend on other departments for its engineering service. Senator Inman here remarked that this would require more appropriation of money and might be very unpopular with the people. I replied that of course I realized the situation and hoped the committee would arise to the occasion and apply the

remedy in order that the telephone industries might get the regulation they require and get it promptly.

"The hearing in a way brought out the fact that the Railroad Commission had done a large amount of work and much remained to be done. There are one thousand utilities under state regulation and since March, 1912, between eight and nine thousand formal cases have been heard and decision rendered and many informal complaints have been adjusted without formality of a hearing. The investigation proved beyond question the great value of the Railroad Commission to the state in every way and ended in a deluge of verbal bouquets showered upon the commission for the good work it has done in stabilizing securities and protecting the public. Sufficient unto the day is the good thereof."

Satisfactory Earnings of the A. T. & T. Co.

Interests in close touch with the management of the American Telephone & Telegraph Company state that final figures covering 1920 operations of the company will show earnings of between $11 and $12 per share on the capital stock, and that in all probability the figure will be near $12. This balance of profits, representing as it does a margin of close to 50 percent over the percent dividend, is not uncomfortably large, but is most satisfactory. The forthcoming annual report will record another year of satisfactory growth. The gain in Bell-owned stations for the 1920 year was more than 560,000, making the total as of December 31, 1920, about 8,240,000. Including stations of outside companies connecting with the Bell system, there is an aggregate of approximately 12,475,000.

Telephone Man Retires After 35 Years of Service

C. A. Lindsay, district manager of the Christian-Todd Telephone Co., has retired at his own request from active duties after 35 years of service, 30 years of which has been spent as manager of the Clarksville (Tenn.) group of exchanges.

In line with a policy of keeping its employes' interest at heart, this company many years ago evolved a plan enabling an employe holding a continuous faithful service record of such length to be retired upon his own request or through disability, the company reserving the right to recall such employe into active service at any future time.

Mr. Lindsay's successor will arrive in a few days and after the transfer of the management, Mr. Lindsay will go to Nashville to be officially notified of his good fortune. He will then take a much needed rest.

A Telephone Operator's Monument

Miss Iva Chapman, telephone operator in a rural community exchange at Wellman, Iowa, did not live—nor die—in vain. She gave the good country folks of her community the opportunity to prove that they could recognize a heroine when they saw one—even though she lived with them in their everyday life. Miss Chapman was day operator, when the night operator was taken ill with the flu in 1918. She worked night and day—keeping the exchange going in summoning doctors, nurses and others to take care of those afflicted. Then she contracted the disease, but did not have the strength left to combat it. In appreciation of her heroic work phone subscribers in that rural community have erected a monument to the memory of Miss Chapman in the little cemetery at that place "in honor of faithful and efficient service."

The Telephone Is a Much Abused Instrument

There are always enough people in a community who abuse the telephone so severely that that highly trained and efficient necessity becomes almost a nuisance. Take for instance the ten and fifteen-minute conversationalists. It hurts one's brain to think up a conversation of such importance that it requires fifteen minutes of telephone talk and if such do occur more often than once or twice a year, they are so important that the participants ought to have a party line of their own and thus be saved the annoyance of having some one break in on their business.

Is anything more of a tax upon good nature than to take the receiver of a telephone two or three times during a ten-minute period and find the line occupied with a conversation between two people in which the bulk of the talk is a lot of unimportant gossip punctuated by intervals in which the gossipers must stop to think up something new about which to converse, or find it taken up with the prattle of a cooing couple who nine out of ten chances have said "good-bye" in person a few hours before or expect to meet again a few hours later.

These are only two of the annoyances to which telephone subscribers must submit and over which the telephone company has no control.

Long distance conversations are out of place in this day when the telephone is no longer a convenience but one of the veritable necessities of life.

A lot of criticism over "Busy Lines," inability to get your party or to obtain a quick response from central is wrongly directed at the telephone girl or the company where as a matter of fact most of it should be placed at the door of unthinking subscribers who do not seem to know that they are only a small part of the great number of people who have come to depend on the telephone as a vital factor in their every-day lives. The telephone was invented and perfected to use but not to abuse with unnecessarily lengthy and unimportant conversations for the service an exchange renders to a community can be easily upset and disturbed by a comparatively few people forgetting that the telephone is designed for public and not private service.

Texas Convention at Dallas, March 23-25

In a letter to telephone men inviting them to attend the Texas convention, Oscar Burton, secretary of the Texas Independent Telephone Association, says:

The annual convention of the Texas Independent Telephone Association will be held at Dallas on March 23, 24 and 25, 1921. The entire week, beginning March 20, has been set aside for the Texas bunch without conflict with any other state convention.

The Adolphus Hotel management has agreed to turn the hall over to us on Monday morning, the 21st, so as to give the exhibitors ample time to set up before the convention opens on Wednesday. We will have the left wing of the roof garden (same as last year). A committee will be on hand to assist exhibitors in getting located and to take care of reservations. We will have ample space and hope you will take advantage of this opportunity to meet two or three hundred Texas telephone men.

And don't fret about conditions in Texas. We are staging a comeback right now. Of course we would not say business is normal, but you may be sure that Texas telephone men are taking advantage of this "breathing spell" to plan wisely for the future, and, barring some calamity, we predict an era of building next year.

At least we promise you a good time in a glassed-in roof garden, and the Texas bunch is apt to spring a surprise of some sort.

Nebraska's Annual Convention

An Interesting Meeting of the Nebraska Telephone Association Held at Lincoln February 15-16

The annual convention of the Nebraska Telephone Association was held at Lincoln on February 15 and 16. W. S. Clapp, of Kearney, called the meeting to order in the absence of the president, Warren Pratt, who was ill. Secretary L. E. Hurtz, Lincoln, addressed the members at some length and touched on other matters of importance requiring attention during the year.

V. E. Wilson, formerly a member of the state railway commission, spoke at length at the Tuesday afternoon session on "What Disposition Should Be Made of Stockholders' Sacrifices, Donated Services and Deferred Dividends?"

He digressed long enough to express the profound and sincere opinion that if Commissioner T. L. Hall, who has just retired after nine years' service, had been able to secure the acquiescence of other members of the commission in his views, "every utility in the state would have been compelled to invoke the protection of the courts to avoid bankruptcy, and the service would not only have deteriorated greatly during the delays inseparable from court action, but the rates would have been materially greater in the end, owing to the expense of legal proceedings and the reluctance of capital to invest in properties under attack." He added that a much higher rate of return would have been necessary in order to attract the additional capital required for extending and bettering the properties.

Mr. Wilson was led to make this statement by reciting the facts regarding the Gage County Independent Telephone Co., which had been finally forced by Mr. Hall's course of conduct to relinquish the right to return on $10,000 or $12,000 of stockholders' sacrifices to which it was entitled. He said that returns invested in the property by way of sacrifices and deferred dividends are entitled to the same treatment in the way of a return that is accorded to the contributions of capital.

The company could have paid the dividends on condition that the stockholders immediately purchase the equivalent in stock, and merely because it did not use this formality does not affect the stockholders' rights to a return upon the contribution. Mr. Hall in public denounced these as compound returns, but privately admitted that this was not true.

In a discussion on utilities, H. G. Taylor, chairman of the Nebraska Railway Commission, stated that during the war the utilities believed they were passing through a most trying period. They were, and when the armistice was signed everybody felt that it was over. The fact is that the past year and a half have been just as trying a time for telephone companies. The return to peace was followed by abnormal conditions, unfavorable labor and material costs, and a psychological public condition under which the problems of the utilities multiplied rather than decreased.

Following Mr. Taylor's remarks, the following committees were appointed:

Credentials: J. D. Crownover, Sargent; E. D. Piper, Gibbon; and R. E. Mattison, Lincoln.

Membership: J. E. Bagstrom, Wausau; J. A. Dixon, Arlington; and R. E. Louden, Stapleton.

Resolutions: Bruce Brown, Brady; B. G. Miller, Crete; and E. D. Warner, Scottsbluff.

Entertainment: L. E. Hurtz, Lincoln; W. E. Bell, Lincoln; and Ole Christiansen.

Finance: I. C. Steele, Ohiowa; L. E. Hurtz, Lincoln; and J. L. Wait, Arcadia.

Nominations: John W. Richmond, Wisner; E. C. Hunt, Malmo; and R. E. Mattison, Lincoln.

A banquet followed the first day's session, after which the telephone men attended a theater.

SECOND DAY'S SESSION.

At the opening of the meeting, C. L. Kelly, North Bend, read a paper giving a comparison of costs of furnishing service on farm and city lines. He was followed by Charles C. Deering, Des Moines, secretary of the United States Independent Telephone Association, who devoted his talk to the legislative situation confronting the industry in so many states.

"Efficiency" was the theme of Bruce Brown, Brady. He declared it to be the greatest factor in success. Know your business thoroughly, how everything is done, and then let your subscriber know. This is essential in the case of small companies where specialization is impossible and where the company is not big enough to have this cost swallowed up in the overhead.

Following Mr. Brown, C. J. Garlow, Columbus, read a paper on "What Are Adequate Rates?" in which he handled the subject in an exhaustive way.

W. L. Lemon, Lincoln, discussed some suggested changes in the railway commission's accounting system, and later there were formally adopted by the convention. Mr. Lemon said that records should be kept in detail so that the history of a company may be determined in the future without a doubt, and in such a manner that a true analysis of the investment, revenues, expenses and the reserves can be readily made.

In the past, the smaller companies had not done this. They paid their dividend at the end of the year if sufficient funds were on hand, although they were unable to determine from the records kept whether their net income was large enough to do so. Better treatment from commissions and new capital needed can be secured if a true balance sheet can be shown at any time. He thought the system of accounting would develop valuable statistical information for managers.

He suggested that each of the repair accounts kept should be subdivided so that one represents only ordinary current repairs and the other the expense in connection with replacing, renewing or reconstructing existing plant. It would not be necessary to change the forms, while the information gained would be of the utmost importance to the commission and the companies affected.

The association elected Bruce Brown, of Brady, as president; vice president, George E. Becker, Pawnee City; secretary-treasurer, R. E. Mattison; directors, P. B. Cummings, North Bend; Frank H. Woods, Lincoln; Warren Pratt, Kearney; Lloyd Wilson, Omaha; E. D. Warner, Scottsbluff; C. J. Garlow, Columbus; E. C. Hunt, Malmo, and J. E. Bagstrom, Wausa.

District vice presidents: E. H. Towle, Falls City; J. H. Christiansen, Blair; J. W. Richmond, Wisner; B. G. Miller, Crete; R. L. Keester, Alma, and J. D. Grint, Sargent.

The convention adopted a resolution expressing its sincere regret over the retirement from the telephone industry of L. E. Hurtz, general manager of the Lincoln Telephone & Telegraph Co., and the appreciation of the association for his valuable services in the past. President-elect Brown, on behalf of the members, presented Mr. Hurtz with a loving cup. This came as a surprise to the recipient, but he rallied sufficiently to express his appreciation of the honor.

The final action of the convention was to organize as a lobby in boots and call upon the legislative committee having in hand the eight or ten objectionable bills and ask that they be killed. A. S. Kelly acted as spokesman.

The Measurement of Resistance

An Exhaustive Article on This Most Important Phase of Telephone Work

By C. A. WRIGHT
Professor of Telephony,
Ohio State University.

RESISTANCE measurements of telephone lines and circuits are made for routine purposes such as to determine their normal conductor resistance of insulation resistance, or the condition of the lines or circuits with regard to these characteristics, and to locate faults in telephone lines such as grounds and crosses. Resistance measurements are made of windings of coils and relays and of other apparatus and insulation resistance measurements, of wire and cable, to ascertain whether or not they are as specified.

All of the methods used of measuring resistance are more or less direct applications of Ohm's law—that the electromotive force across a circuit or part of a circuit divided by the current flowing through the circuit equals the resistance of the circuit. Ohm's law is true because the units of electromotive force, current, and resistance, the volt, the ampere, and the ohm, represented by the symbols E, I, and R, were chosen of such magnitude that it is true. Expressed symbolically, Ohm's law is

$$R = \frac{E}{I}.$$

Generally, except in Wheatstone Bridge measurements, resistance cannot be measured directly. It is necessary to obtain current and voltage, and, from their ratio, resistance.

Electromotive force and current may be read directly by means of the instruments represented in Figs. 1 and 2. These instruments are really low sensibility D'Arsonval galvanometers, and are of the type used for all direct current measurements of telephone circuits.

Fig. 3 shows a meter of this type. It consists of a coil of fine wire wound on a frame of aluminum, which moves in the uniform field of the permanent magnet. A light pointer attached to the coil moves over the scale. The motion of the coil is opposed by fine spiral springs, by which it is also connected to the stationary circuits of the instrument. As the strength of the field of the permanent margnet is constant, the tension of the springs proportional to the movement of the coil, and the strength of the field of the movable coil proportional to the current through the instrument, the deflection of the coil and pointer is proportional to the current through the coil. This instrument in series with a resistance, as in Fig. 1, may be used to measure electromotive force, or as a voltmeter, and in parallel with a resistance, as in Fig. 2, it may be used to measure current, or as an ammeter. The current through the movable coil is always proportional to that through the instrument. The range of the voltmeter or ammeter is determined by the magnitude of the series or parallel resistance.

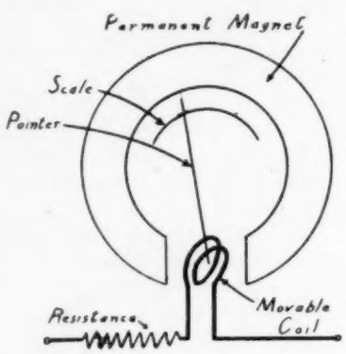


Fig. 1. Voltmeter.

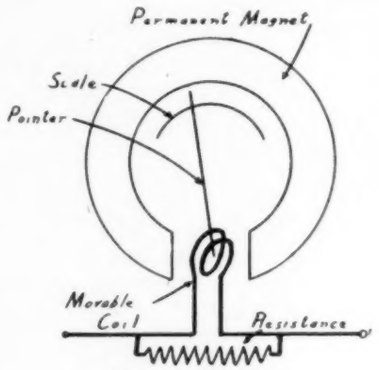


Fig. 2. Ammeter.

A D'Arsonval galvonometer is in principle like the voltmeter and ammeter described above, except that its suspension is much more delicate and free from friction, making it more sensitive electrically but less rugged mechanically. A D'Arsonval galvanometer is shown in Fig. 4.

The ammeter-voltmeter method of measuring resistance is a simple and convenient method of measuring resistances of moderate magnitude. However, it is not one of the greatest accuracy. Voltage and current are measured by means of a voltmeter and an ammeter. The resistance is the quotient of the voltage by the current. Fig. 5 shows the method of connecting apparatus to measure resistance by this method. An error results from either of the methods, "a" or "b," of connecting the volt-

Fig. 3. Voltmeter.

meter. If the connection "b" is used, the voltmeter reading includes the drop in voltage in the ammeter; and if the connection "a" is used, the ammeter reading includes the current through the voltmeter. If the resistance of the voltmeter and ammeter are known, as is generally the case, corrections may be made. Frequently strict accuracy is not as important as convenience and quickness in obtaining the desired resistance, but the greatest accuracy easily obtainable is desired. In such a case, if no corrections are to be made, the connection shown at "a" is more accurate for the measurement of low resistances and that shown at "b" is more accurate for higher ones.

This method is better adapted to the measurement of resistances such as coil resistances than to that of telephone lines.

It is often found to be desirable to measure the insulation resistance of

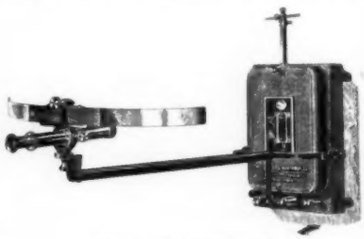


Fig. 4. Galvanometer.

wire by this method. As the insulation resistance is high and, with the test voltage obtainable, the current very small, a galvanometer is generally substituted for an ammeter. Correction may be made for the resistance of the galvanometer, although in most cases it

is so small in comparison with the resistance of the insulation that no account need be taken of it.

When the insulation resistance of a sample of wire is measured in this way, the wire, except the ends, is generally immersed in salt water. The circuit

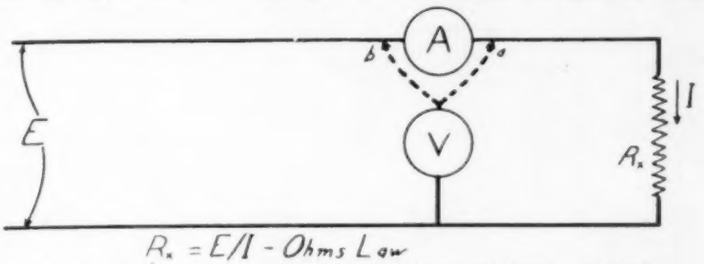


Fig. 5. Measurement of Resistance By Ammeter-Voltmeter Method.

then is from the testing battery to the tank containing the water, through the water and the insulation under test to the wire and through the galvanometer to the other pole of the battery. The voltage impressed upon the circuit is measured with a voltmeter. As most circuits of this kind have some electrostatic capacity, sufficient time for this capacity to charge and the readings to become constant should be allowed before the readings are taken. Error due to leakage of current over the ends of the insulation should be avoided by coating these ends with paraffine, or by connecting the insulation close to the conductor to the battery by a "guard circuit" in such a way that the leakage current does not pass through the galvanometer. The circuit, especially the side in which the galvanometer is connected, should be well insulated.

Some insulation resistance may be measured by the loss of charge method, in which the rate of loss of charge of a condenser through the resistance under test is a measure of the resistance.

For measuring high resistances such as the insulation resistance of a telephone line, the voltmeter method is generally most convenient and satisfactory.

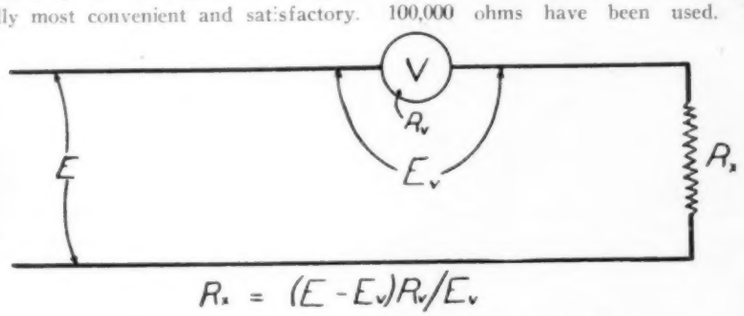


Fig. 6. Measurement of Resistance By Voltmeter Method.

This method is an application of Ohm's law, in which both the current and voltage from which the resistance is determined are obtained indirectly. The total test voltage, E, is measured. Then the voltmeter is connected in series with the unknown resistance, and the voltage across the voltmeter, E_v, is obtained. The voltage across the unknown resistance, R_x, then is $E - E_v$.

The resistance of the voltmeter may be easily obtained. If this resistance is R_v, the current through the voltmeter when it is in series with the unknown resistance, and therefore the current through the unknown resistance, is E_v divided by R_v. Applying Ohm's law, the unknown resistance is $(E - E_v)$ divided by E_v/R_v, or

$$R_X = \frac{(E - E_V)\ R_V}{E_V}.$$

Assuming that inaccuracy in measurement results from the error in observing the position of the pointer on the scale of the meter, the most accurate measurements are obtained when the pointer is at the midpoint of the scale, that is, when the unknown resistance equals the resistance of the voltmeter. Meters with resistances of 10,000 to 100,000 ohms have been used. The greater the resistance of the meter, the greater is the unknown resistance which can be measured accurately. As the insulation resistances of most subscriber's loops and toll lines are greater than 100,000 ohms, the meter of the higher resistance will generally be found to be most satisfactory. However, for a given test voltage, the sensibility and the cost of the meter must be greater for the 100,000-ohm resistance than for the lower resistances.

Test voltages of 30 to 150 volts have been used satisfactorily. The higher voltages make possible the use of higher meter resistances for a given sensibility, but there are objections to the higher voltages, such as the difficulty of maintaining the test batteries. The insulation resistance of a wire or cable is inversely proportional to its length. This follows from the fact that the cross section of the path of the current increases directly as the length of the wire or cable.

A meter with a resistance within the above range would evidently not be suited to the measurement of comparatively low resistances such as conductor

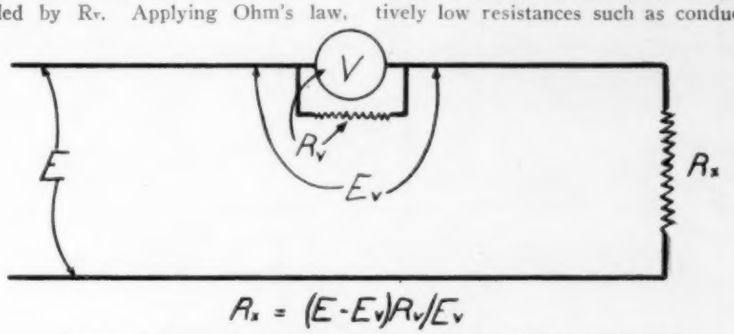


Fig. 7. Measurement of Resistance By Voltmeter Method. Voltmeter Shunted for Use With Low Resistance.

and loop resistances. The use of a shunt with the meter which will make the combined resistance of the meter and shunt 200 or 400 ohms, and the use of test voltages of 2 or 4 volts, have given satisfactory results for such conditions. Figs. 6 and 7 show meters without and with a shunt, connected to measure resistance.

If there is a cross of a line, it may be located by measuring the resistance from both ends, the complete loop resistance having already been determined. Suppose the loop resistance to be L ohms, and that the resistance measurement from one end is a ohms and from the other b ohms. The resistance of the cross has been included in each measurement. The difference between the two measurements is the difference between the resistances of the two sections of line, $a - b$ ohms. Their sum is $a + b$ ohms. If $x + y$ are the resistances of the two sections,

$$x + y = L, \text{ and } x - y = a - b, \text{ or}$$

$$x = \frac{L + a - b}{2} \text{ ohms, and}$$

$$y = \frac{L + b - a}{2} \text{ ohms.}$$

These are the loop resistances from the

ends of the line to the fault. The resistance of the fault is

$$\frac{a+b-L}{2} \text{ ohms}$$

If three conductors are available, they may be looped and measured in pairs.

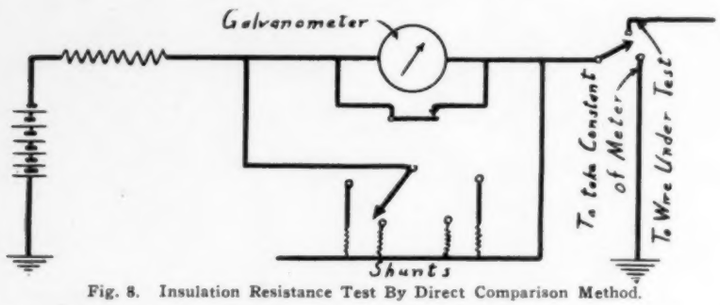


Fig. 8. Insulation Resistance Test By Direct Comparison Method.

If their resistances are x, y, and z, and if the loop resistances are a, b, and c, or

$$x+y=a,\ x+z=b,\ \text{and}\ y+z=c,$$

$$x=\frac{a+b-c}{2}$$

$$y=\frac{a+c-b}{2}, \text{ and}$$

$$z=\frac{b+c-a}{2}$$

For routine testing of insulation resistance, a sensitive relay in series with a battery, one side of which is connected to ground, may be used. The relay operates a sounder. The relay and battery are connected by means of special plugs to the conductors of the lines to be tested. If the insulation resistance is below a certain value, the relay operates, operating the sounder.

A common method of measuring insulation resistance is by means of a portable galvanometer, which is provided with galvanometer shunts and a standard high resistance, generally about one-tenth of a megohm. The circuit of such a galvanometer is shown in Fig. 8. The unknown resistance is measured by comparing the deflection obtained from the current through the unknown insulation resistance in series with the standard resistance with the deflection obtained from the current through the standard resistance alone. The standard resistance is ordinarily left in circuit in series with the unknown insulation resistance to protect the galvanometer if the insulation resistance should be very low because of a ground on one side or the other of the line.

The Wheatstone Bridge method of measuring resistances is more accurate than the methods described above for very low and very high resistances. It has also been much used by telephone men for locating faults, because measurements independent of the resistance of the faults may be made. The circuit of a Wheatstone Bridge is shown in Fig. 9.

When the resistances are adjusted so that it is balanced, that is, so that no current flows through the galvanometer, $I_a = I_r$, and $I_b = I_x$. As the potential or voltage between points 1 and 2 is zero, the voltage $I_aR_a = I_bR_b$, and $I_rR_r = I_xR_x$. If we divide equals by equals, the quotients are equal. Therefore,

$$\frac{I_aR_a}{I_rR_r}=\frac{I_bR_b}{I_xR_x}, \text{ or } \frac{R_a}{R_r}=\frac{R_b}{R_x}, \text{ or}$$

$$R_x=\frac{R_bR_r}{R_a}.$$

R_x is the unknown resistance, R_r is the variable resistance or rheostat, and R_a and R_b are the ratio arms. They are usually designed so that their ratio is 1,

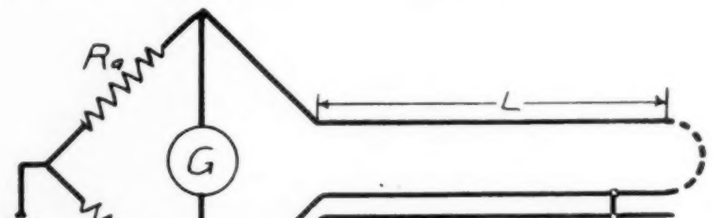


Fig. 10.

a multiple of 10, or a multiple of 1/10.

An ohmmeter is an instrument from the scale of which the resistance under test may be read directly. One ohmmeter which is much used consists of a standard resistance, slide wire with scale, and a telephone receiver, which is used as a detector in place of a galvanometer. The standard resistance and slide wire form three arms of a Wheatstone Bridge, and the resistance under test, the fourth arm. Such an instrument may be provided with several standard resistances and scales to correspond, which make it possible to adapt the instrument to the measurement of as many ranges of resistances.

It is sometimes desirable to measure a resistance too great to be accurately measured directly by means of a Wheatstone Bridge. The resistance may then be measured by connecting it in parallel with a resistance low enough to be measured directly with the bridge. If Y is the resistance which may be measured

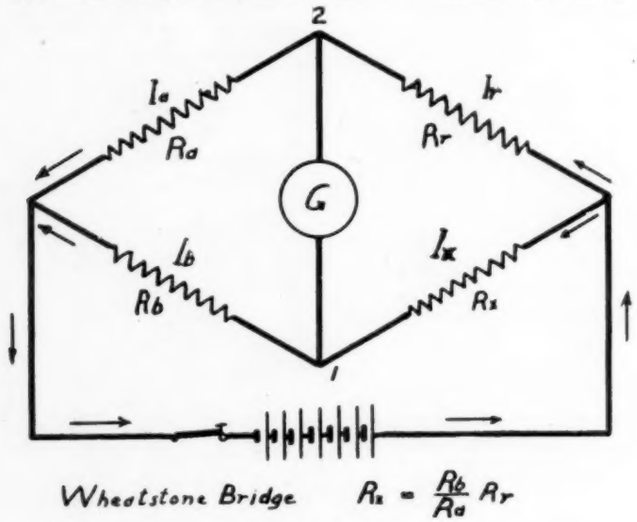


Fig. 9.

directly, Z the combined resistance, and X the high resistance to be tested,

$$X = \frac{YZ}{Y-Z}.$$

The Wheatstone Bridge and various modifications of it have been found to be very adaptable to measurements of telephone lines. Two modifications which have been much used have been the Varley and Murray loops. In the Varley loop the balance is obtained by adjusting a rheostat as R in Fig. 10, while in the Murray loop the rheostat is admitted and the balance is obtained by adjusting the ratio arms as in Fig. 12. When the ratio arms are adjusted by moving the midpoint to which one terminal of the battery is adjusted, A_a and R_b are varied in opposite directions. While the Murray loop in most cases may be most readily manipulated, in some cases the computations which must be made from settings of the Varley loop are very simple, and may more than compensate for advantages of the Murray loop. The greatest advantage of both of these modifications of the Wheatstone is that they may be arranged so that the faults are in the battery or galvanometer circuits and are not a serious source of inaccuracy in measurements of loops or conductors. By taking full advantage of this fact the measurements may be made independent of the resistance of the fault.

In Fig. 10 is shown a Varley loop circuit for locating grounds. When the bridge is balanced,

$$\frac{R_a}{R_b} = \frac{2L-X}{R+X}, \text{ or}$$

$$X = \frac{2R_bL - R_aR}{R_a+R_b}, \text{ where}$$

R_a and R_b = resistances of the ratio arms
R = resistance of the rheostat
2L = loop resistance
x = resistance to the fault

The Varley loop shown in Fig. 11 is arranged for locating crosses with other circuits. If the symbols used have the meanings given above,

$$X = \frac{2R_bL - R_aR}{R_a+R_b}$$

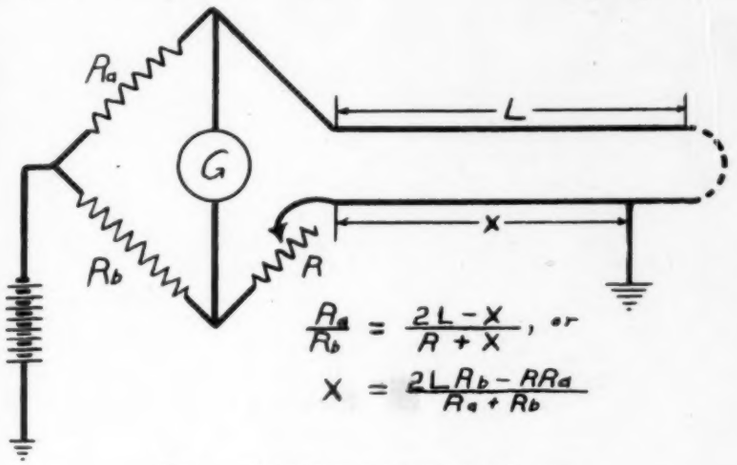


Fig. 11. Varley Loop for Location of Crosses.

For example, if the ratio arms, R_a and R_b, are made equal, the equation becomes

$$X = \frac{2L-R}{2}$$

If 2M is the resistance per loop mile, the distance from the testing station to the fault is

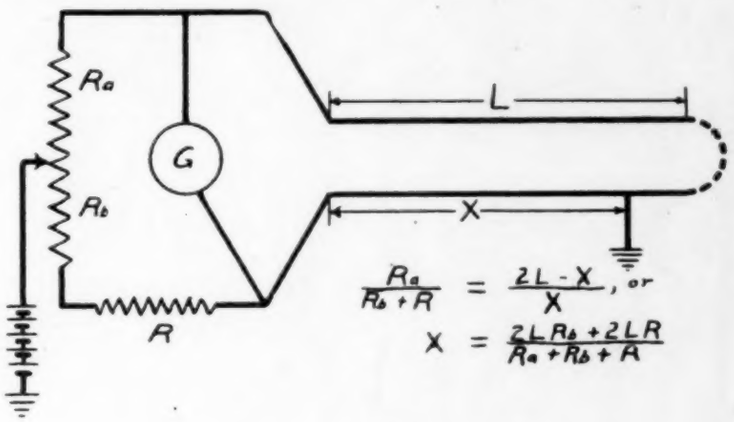


Fig. 12.

$$d_1 = \frac{2L-R}{2M}$$

and the distance from the distance test station at which the line was looped to the fault is

$$d_2 = \frac{2L}{2M} - \left(\frac{2L-R}{2M}\right), \text{ or } \frac{R}{2M}$$

Such results make possible convenient and rapid calculation of the distances d_1 and d_2.

If these same meanings are attached to the symbols used with the Murray loop for locating grounds, in Fig. 12,

$$\frac{R_a}{R_b+R} = \frac{2L-X}{X}, \text{ or}$$

$$X = \frac{2L(R_b+R)}{R_a+R_b+R}.$$

If it is desired to locate a fault on a line of which both conductors are the same throughout the length of the line, the Murray loop may be used advantageously. If D is the length of the line, and d_1 is the distance to the fault,

$$\frac{X}{2L} = \frac{d_1}{2D}, \text{ and } d_1 = \frac{2D(R_a+R)}{R_a+R_b+R}.$$

Neither the resistance of the loop or the resistance per loop mile need be known, and the temperature of the wire when tested may be neglected.

There are many different conditions involving faults, for the measurement of which systems of Varley and Murray loop and other circuits may be devised.

In cases where loop or wire resistances, or resistances per loop or wire mile are involved, allowance should always be made for the change in resistance with change in temperature. This change is shown by the equation:

$$R_t = R_o(1 + {}_aT), \text{ where}$$

R_T = resistance at T° C.
R_o = resistance at o° C.
a = temperature coefficient

The temperature coefficient differs with the material under construction. It is .00427 for copper and .00527 for iron.

A Private Line

Teacher—When did William the Conqueror come to England?

Pupil—I don't know.

Teacher—But doesn't it say in your book, William the Conqueror, 1066?"

Pupil—Yes; but I thought that was his telephone number.

The Telephone in Foreign Countries

Items of General Interest to Telephone Men From All Parts of the World

By G. F. BUNKER

New Exchanges Planned for London

A scheme which will take about twenty years to complete proposes the equipment of sixty additional telephone exchanges in the London area. The 30,000-line Tower exchange in Great Tower street is nearing completion, and will probably be the first to be placed in operation. A temporary exchange, which is being contsructed to relieve the congestion will be out of the architects' hands this month. The Stratford exchange will be finished, so far as the builders are concerned, in April, when its equipment will begin. The Holborn exchange, near Chancery Lane, is in an early stage of construction, but a temporary exchange near by will be in commission in a few months' time. The Berkeley exchange will relieve the pressure on Mayfair; it is being equipped, and sites have been selected for thirteen other exchanges, including the Strand, Sloane, Golder's Green, Langham or Marylebone, Battersea, and Woolwich. The Strand exchange will deal with 30,000 lines, and will be situated near Covent Garden; a temporary Langham exchange is being erected on top of the Western District Post Office, and another is to be built in Queen's Road, Hendon, while a 30,000-line exchange is to be installed in Wood street, Cheapside. A new automatic exchange is to be established at Blackfriars, and if successful it will be widely extended.

Recently the telephone services of Milnsbridge, near Huddersfield, were transferred from the old exchange in Armitage Road to the new building in George street. This exchange should have been in operation long ago, but the work was held up by the war.

Increased Telephone Costs in England

Giving evidence in London before the House of Commons committee on telephone charges, the assistant engineer-in-chief to the postoffice said that the cost of labor and material for the construction of underground lines had gone up 236 percent. The over-all increase for plant installed had gone up 204 percent. The figure representing the cost of administration and operating expenses had gone up from £1,500,000 in 1913-14 to £4,710,000 in 1920-21. The increase was due partly to the normal developments of the system and partly to the increased wages. The costs kept pretty well level as the system increased. There was a research school, and a small number of awards had been given for inventions by minor members of the staff. Plant was coming in very slowly. It was the policy to continue underground cabling wherever possible. It was more economical.

New Telephone System for Uruguay

The only tender received for the construction of a telephonic system in Montevideo was that of the International Eastern Electric Company, Inc., which offers to construct the underground telephone system, together with the necessary plant, offices, etc., for a maximum price of 6,943,500 pesos, and a minimum price of 6,647,000 pesos, according to the variations which it might be necessary to introduce in the course of the work. The initial lines would provide for a service to 16,500 subscribers, while extensions are in view providing for 46,500 subscribers and a connection with the telephone system of Buenos Aires.

Automatic Telephone for Italy

The plans have been prepared for the conversion of the telephone network of Rome to the automatic system, with the cables laid underground. For this purpose the city has been divided into seven zones, each to be served with its own exchange. Two of these zones are to be taken in hand at once. The scheme is a part of a general plan to reform the telephone system in all the large towns of the peninsula.

The work has already been begun on the construction of the new urban telephone network in Venice. Some 14,000 meters of cable are to be laid underground, and in view of the peculiar nature of the soil, topographical conditions, and the narrow and tortuous streets, the work represents a unique task. The cables will be laid in wooden troughs filled with asphalt. The 6,000 pairs of conductors will be carried from the underground cables to the most suitable points of the city by means of 33 rising columns, and branched off by aerial cables in all directions for the service of existing subscribers as of those foreseen from the extension of the network up to the year 1930. It is anticipated that the completion of the installation will take at least 15 months.

Developments in the Fiji Islands

A telephone in every white man's home on Fiji!

That is the goal of Superintendent of Telegraphs and Telephones, C. F. Monckton. He is enlarging the system to provide for 1,200 subscribers instead of 400 and soon this outpost of civilization will boast of a modern telephone system. The new system will do away with the old "twist the handle" to call the operator type of telephone in use heretofore and three operators will be required to handle the entire telephone business of Fiji against one operator in the past.

Huge Cable Project in Sweden

Somewhere out on the Atlantic at the present time, the Swedish steamer, *Stureholm* is plunging ahead towards Stockholm bearing the first installment of what is probably one of the most important electrical shipments ever made from this country to Europe. Twenty-four carloads of underground cable apparatus is now on its way to the other side.

The shipment is part of the gigantic underground cable system which the Swedish government intends to install between Stockholm and Goteborg. It will be 320 miles long. When it is completed, it will be the greatest underground cable line in Europe, and second in the world only to the 450-mile line now operating between Boston and Washington. It will be capable of carrying two hundred conversations simultaneously from Stockholm to its other terminus.

To complete the big Swedish project, it will be necessary to manufacture a total of 425,000,000 conductor feet of cable, 25,000 loading coils and eight repeater stations with 300 repeaters. If this all were connected in series it

would give an amplification sufficient to enable one to talk over a cable circuit, 15,000 miles long, or an unloaded open wire circuit 125,000 miles long, or a loaded open wire circuit 300,000 miles long, or about twelve times around the earth.

Mr. A. H. Griswold, assistant chief engineer of the International Western Electric Company, has just returned from Sweden where he has been making arrangements for the installation of the big cable line. When interviewed, he said that it would require about a year and a half to put the system into operating condition. The work will require about a thousand workmen in addition to a large staff of engineers.

An idea of the magnitude of the new Swedish line of communication can be gleaned from the fact that 6,500,000 lbs. of lead and 3,350,000 of copper are being used in its manufacture.

The shipment of the apparatus from the works of the Western Electric Company at Hawthorne, Illinois, where it is being rushed to completion, will consist in all of 1,861 reels of cable, 260 loading coil cases and other miscellaneous material totalling about 7,200 tons.

Making Farmers' Telephones Pay the Farmer

An Article on Rural Telephones from Farm and Ranch Showing the Telephone to be a Business Necessity on the Farm

By A. W. ROSE

"WE have just had our telephone removed," Mrs. Meadows remarked to Mrs. Norton, her new neighbor. The Meadows recently had moved into the hustling rural community of Benders, from a region not noted for progress.

"Well, we couldn't do without ours," Mrs. Norton replied as she bustled about, busy with the packing of some fresh eggs for the market.

"I know they are mighty handy instruments to converse through," Mrs. Meadows continued, "but Jack says they are just a useless expense and that he has no time to stand to the telephone and listen in while other folks is gassing off."

Just then the telephone in the hallway rang. Mrs. Norton excused herself and went to answer.

From her place in the sitting room, Mrs. Meadows caught bits of the conversation and her eyes were big with wonder when Mrs. Norton returned.

"And are you really getting 60 cents a dozen for your eggs?" she asked.

"That's what these are to bring at the Co-operative store."

"My! Jack never got but 40 for those I sent in yesterday."

"Perhaps they weren't engaged."

"They weren't. Do you always engage yours?"

"Yes, and usually I engage as well all the other produce that we have to sell," Mrs. Norton continued. "You see that is how the telephone pays for its keep. Whenever we have anything for the market, I take the time to use the telephone in finding the best market for it. Just let me explain my system, if it is elaborate enough to be called a system."

Then Mrs. Norton led her acquaintance into the hall, where a telephone receiver hung on a hook, resting on a desk that was fitted up with day books, ledgers, ink wells and pens, very much in the style of an up-to-date business office. The Nortons believed in facts and figures when it came to striking a balance between profit and loss on the farm. Mrs. Norton seated herself at the desk and explained:

"See this small notebook? Well, it contains entries of practically everything in cellar, barn, garden and yard that is ready to sell now. William works as hard as any husband about here, I suppose; he attends largely to the production end of the farm and under his direction I have taken over the selling end. This notebook, plus the telephone, are my chief assistants. Every morning I devote a few minutes to seeing if the local trade will take anything from us. As you know, we are specializing on the growing of vegetables and chickens, but as our farm is large and has a variety of fruits on it, we nearly always have quite a number of things to offer. We now have a well established trade in Benders. Often the merchants themselves call us up when they need some certain country produce they know we have. With my notebook within reach, I can easily find if we have it on hand or when we may have it, book the order, and then William can make the delivery in the Lizzie.

"We used to figure, too, that the telephone was an expense, but we think differently now. Instead of considering it as an expense, we know now that it is an asset, and we would as little think of doing without it as we would the flivver, the stock or the farm tools. Instead of the telephone being an added expense, we figure it as a necessity and as an actual asset in our ability to place our marketable produce at a higher rate than we would be able to do if we did not use the telephone."

The conversation was the beginning of the turn of the tide in the financial affairs of the Meadows. As related before, they had just removed to Benders from a community where progress was at a standstill, and when they came to Benders they had a lot to learn about making the odds and ends help swell the family purse. When Mrs. Meadows returned home, she told her husband how the Nortons used their telephone to attain such remarkable results. Although dubious, Mr. Meadows had his telephone reinstated, and they began to follow in the footsteps of their more progressive neighbors. They found the method of engaging their produce by telephone much more profitable than to load it blindly in the wagon, take it to town and trust in the magnanimity of the merchant to give them the best price for it. They, too, have made the telephone pay for its keep.

SUCCESS TALKS
DETERMINATION
By S. A. CHANDLER

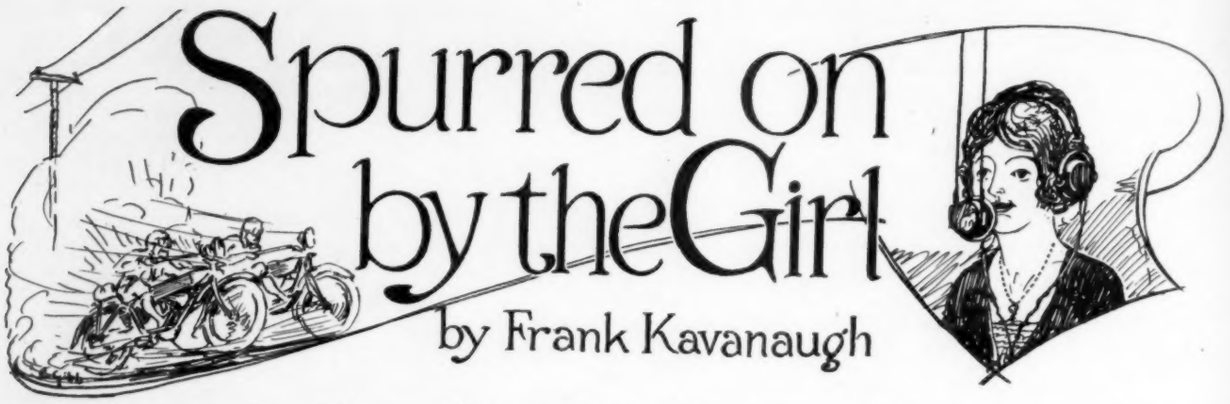
A man may have plenty of ambition, ability and energy and still fail to succeed. Ambition merely urges him on to succeed; energy is necessary to back up the other two, for energy is strength; and a man must have strength equal to his ability and ambition to gain the fullest measure of success. But none of these alone, nor all of them together, will insure success until he adds determination.

Suppose there were a heavy weight which he desires to lift. Possibly one of his friends has lifted it, or has tried to and failed to lift it. Possibly he merely wishes to try his strength. He may have all the desire in the world to accomplish that very feat, but until he determines to try and bends to the task, he'll accomplish nothing.

It is not claimed that an office boy with an office boy's ability will become president of his company if he remains with the firm; nor that the ordinary salesman will some day become his company's sales manager; but it's a well known fact that office boys who backed up their ambition and ability with well directed energy and determination have become presidents of some of our largest institutions; likewise, apparently unknown salesmen, eager and determined to step into the sales manager's shoes, have been able to do it.

Lots of us have ambition, cleverness and stamina, but it takes the triphammer blows of determination to center all our thought and energy on one head to drive through to success.

(Copyright, 1920, by S. A. Chandler)



Spurred on by the Girl

by Frank Kavanaugh

BILLY McGREW hitched his trousers belt tighter, grasped the telephone pole, sunk his climbers in the soft wood and walked up to where the wires rattled on the insulators with the morning breeze. He leaned over, sunk the climber attached to one foot deep in the wood, swung a leg around the pole and fastened each wire of his test set to a wire. Then he put the receiver to his ear just in time to hear:

"That you, Charley? The line is all right down to here. I've nibbled on that candy you gave me last night all morning and I can't tell you how I like you for being so thoughtful. You must be in by six tonight for I do want to see you. All right."

Billy gritted his teeth. He knew the voice well enough and he knew who "Charley" was, although he couldn't hear his voice. Charley was the "trouble shooter" on the other end of the telephone line from Rosebud, and the feminine voice was that of Nora Millard, day telephone operator at Rosebud. Billy also knew that Charley had been out to fix a break in a line on his territory, but what he did not know, until he heard it, was that Nora was accepting candy from the other man. So he waited fully a minute after the wire became silent before he twisted the signal on his test set.

Back came the reply, from Nora at Rosebud:

"Rosebud!"

"Billy talking. How's number six?"

"All right now, Billy. I was just thinking about you. Things are dull this morning. Are you coming in now? Everything's all right now, and few calls coming. If you'll come in by noon we'll go over to drug store and get an ice cream soda. I enjoy them all the more when I drink them with anyone I like—you, for instance. All right."

Billy detached his test set wires from the line wires and looked over the prairie landscape. Far away in the distance a threshing machine was sending a cloud of dust into the air. Over in another field a boy was driving a team of horses attached to a moving machine. Everything was lovely and peaceful, but the heart of the man burnt with a fire that is unquenchable. Then and there he declared war against the man on the other end—Charley. It was war to the death, he knew. The best one would get Nora, and he meant to be the best.

Half an hour later, after driving his motorcycle at top speed for the trip, he stopped at the door of the Rosebud exchange and took the steps up to the office three at a time. "Come and let's get that soda!" he called to the girl at the switchboard.

"In a minute, Billy," Nora said. "Jefferson wants through connection." Into the receiver: "There you are, Jefferson. Got it? Well, I'm off for two minutes."

She took off the receiver and came to the door. Then she turned back.

"Here's a letter for you, Billy. From headquarters, too. Beg pardon—I forgot—it's for you, Billy. Charley got one just the same this morning."

As they walked over to the drug store and ordered the drink, Billy opened the letter and read it. Then he passed it over to Nora. She read it:

"Dear Sir: Since Mr. Owens was promoted from manager at Rosebud to a better position, we have kept the place open, not having a trained man available. In view of the length of your service with the company we feel disposed to promote you. But while we hear good reports of your ability as a lineman, we are not certain whether your ability extends to the business end. You will be credited with all new business secured on your territory for the month of August. On the amount of new business you secure will depend on whether we can give you a managerial position or not."

"If I got this place now, Nora, would you—er—would you—"

"I'm not sure yet, Billy," she said. "I like you, of course, but—Charley got the same kind of letter this morning before he left, you know."

"And you promised him—"

"Just the same as I have you."

"Then the one who wins out gets you?"

"If a man has the ability to get new business for a telephone company, he certainly stands a better chance of getting the girl he wants. Getting a girl is little different from getting business, Billy. And I'd rather have a man who can take care of himself in a business way, of course. Now, I've got to go. Some of those local girls will be getting the toll business all balled up."

"So it's a war of getting business," mused Billy, as he walked to the repair shed. "Let's see—I've never thought of that end of the telephone business. Always thought to keep my end of the lines on good working order. I knew Owens did the collecting, but I never thought he put in any time getting new business, although there are a lot more country telephones here than when he came. So that's why they sent him to the big city. Well—"

That afternoon he went into the country on his territory. The first place he came to that had no telephone was the farmhouse of Widow Briggs. A hundred acres of wheat stubble surrounded the place, and Billy knew she would sell the grain for more than $2 a bushel. He tried to figure what that would make at thirty bushels per acre. The widow was finishing the dinner dishes, and as Billy put his hand on the knob of the door it was suddenly opened from inside and he dodged just in time to escape a deluge of dishwater.

"Why, Billy McGrew!" the widow exclaimed. "I didn't see you and most liked to baptized you with dirty dishwater."

"Why don't you put in a phone, Mrs. Briggs?" Billy asked. "It means a whole lot to me to get new business, and you need one."

"What'd I do with a phone, Billy."

"It'd save you many a dollar?"

"How?"

"You remember the time last week when your hired man broke the piece on the binder?"

"Surely. I told you about that the

other day. But he couldn't have gotten one here by telephone."

"Of course not, Mrs. Briggs, but you told me too that just as he was out of sight going to town for the part of the machine that your horse cut his leg on the wire fence and you had to send one of the shockers after the veterinarian and that left but one man in the field and he couldn't get all the wheat shocked before it rained that night."

"Yes-s-s."

"And you pay the regular man—"

"Fifty dollars a month regular and a dollar a day extra during harvest and corn husking time."

"A phone would have saved you about five dollars that time, let alone what wheat was ruined because it wasn't shocked."

"I never thought of it in that way, Billy," the Widow Briggs said. Then suddenly changing the subject: "It it doesn't look like rain tonight, I'm going to cut that bottom field of hay tomorrow."

"Why not find out what the weather will be tomorrow?"

"There's no weather prophets alive now, Billy."

"Uncle Sam can tell pretty much how the weather will be tomorrow," Billy assured her.

"I don't get the morning paper till the rural carrier comes, and that's 10 o'clock," the widow said. "My men'd be at work four hours by then."

"Phone."

"If I can tell you what the weather will be tomorrow, Mrs. Brigs," Billy said eagerly, "will you sign a contract with me for an instrument."

"If the weather is what you say."

"Excuse me a few minutes."

Billy walked out to the public road, climbed a pole and attached his test set. He rang Rosebud.

"What's the weather for tomorrow."

"Fine, with southerly winds," Nora replied. "Want to go to a picnic, Billy?"

Billy pulled his connection off before he said a word. He ran back to Mrs. Briggs.

"You can prepare to cut that piece tomorrow," he assured her.

"Now I'm going to prepare, and if it rains, Billy McGrew, don't you ever come on this place again. And if it's fine tomorrow come back day after for your contract."

* * *

At about the same time, twenty miles in an opposite direction from Rosebud, Charley was trying out his ability at getting new business. He first tackled old man Jenkins, known to be the stingiest man in the county.

"Why don't you have a phone put in?" he asked.

"Got no money to give away."

The old man was oiling a rusty gangplow.

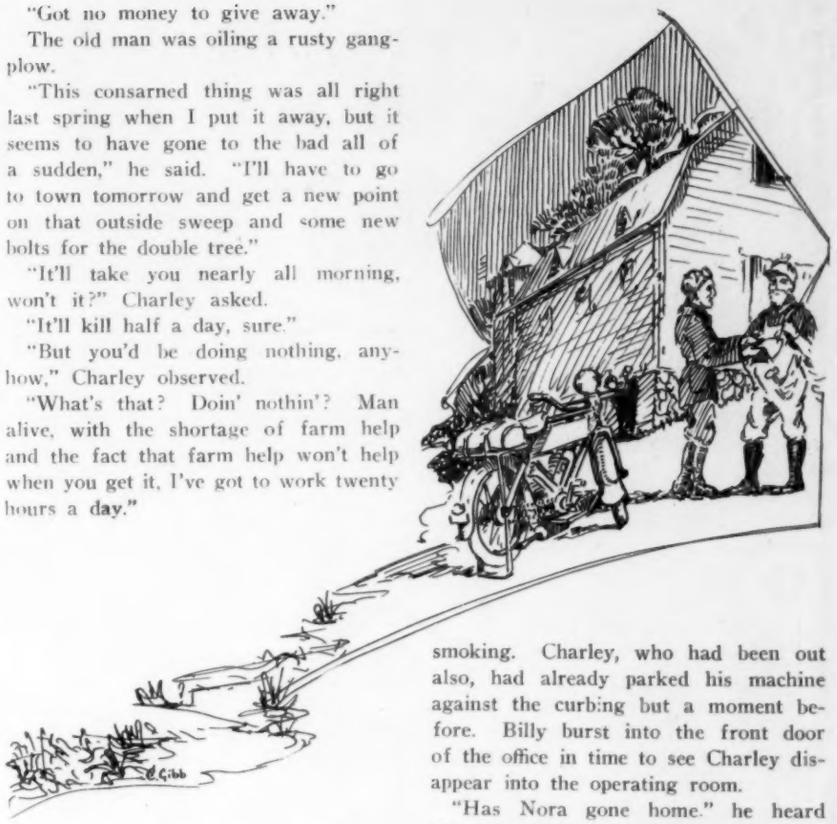
"This consarned thing was all right last spring when I put it away, but it seems to have gone to the bad all of a sudden," he said. "I'll have to go to town tomorrow and get a new point on that outside sweep and some new bolts for the double tree."

"It'll take you nearly all morning, won't it?" Charley asked.

"It'll kill half a day, sure."

"But you'd be doing nothing, anyhow," Charley observed.

"What's that? Doin' nothin'? Man alive, with the shortage of farm help and the fact that farm help won't help when you get it, I've got to work twenty hours a day."



"Then that half day you take to go to town in would amount to something like seven dollars, eh?"

"Per—haps."

"That'll pay for a telephone for about two months."

The old man hesitated and scratched his head.

"By gum!" he exclaimed. "Never thought of that."

"I have a contract here and if you'll sign I'll send your stuff out by the mail carrier tomorrow morning."

"Wait till I get my glasses." To himself: "Save lots o' time and—"

* * *

The day following was fair and Billy got his contract from Mrs. Briggs. From that day on it was a race, nip and tuck, between the two linemen. Every means of persuasion known to them was tried. Nora smiled impartially on them, but slyly checked up the new contracts coming in. On the last day of August Billy lacked one contract of having the same number as Charley.

He was fifteen miles from Rosebud when dark overtook him. For hours he had been hunting through a wooded mile of the road for a "short-circuit." Finally, just as it became too dark to see the wires he discovered it—a hay wire carelessly thrown over the telephone wires. As soon as he had shaken the wire off the circuit he mounted his motorcycle and made speed toward town. He reached there with the machine smoking. Charley, who had been out also, had already parked his machine against the curbing but a moment before. Billy burst into the front door of the office in time to see Charley disappear into the operating room.

"Has Nora gone home." he heard Charley ask the girl at the toll switchboard. He came near to overhear the reply.

"Haven't you heard?" the girl asked, laughing. "Nora went over to the county seat about four o'clock this afternoon and got married to that young druggist that keeps the ice cream parlor across the street. You know how fond she is of sodas."

The girl laughed at the recollection.

"Here's a letter for you, Charley, and one for you, too, Billy."

Billy half dazed, tore open the envelope and read:

"You have shown such energy in securing new business for the company that we have decided you are competent to be placed in charge of the exchange at Grant City. Please report there on the 5th, when the traveling auditor will check you in."

"I opened your letter by mistake, Charley," Billy said. "You get the Grant City managership. I get nothing, not even the girl."

"Nothing but the Aaronsberg managership, Billy, old boy. It says so in this letter. You did nearly as well as I did, after all and the salary's the same at both places. There's nothing like a girl to spur a man on to work, is there?"

"Even when she marries the other fellow," Billy soliloquized. "Let's go over to her husband's soda fountain and drink to the new bride."

Governors Give Views on Utility Regulation

Telegrams from Thirty-six Executives Say Commission Form is Best—Vice President Coolidge Quoted, Courtesy Bell Telephone News

THE attitude of other states of the union as respects regulation of public utilities by state commission is of much interest in view of the discussion which has been had in Illinois relative to that form of supervision of the affairs of the service companies.

To obtain a nation-wide viewpoint, Gov. Charles H. Brough of Arkansas sent a telegram to the governors of all states asking for expressions on the subject. In the message he gave his personal view that he believed "state regulation should be perpetuated." Replies were received by him from thirty-six states, as follows:

The Governor of Arkansas wanted to know how the chief executives of the other states felt toward state regulation of public service corporations. So far he has received thirty-six replies to his query. These upheld this method of regulation.

Henry F. Long, secretary to Governor Calvin Coolidge of Massachusetts (vice-president-elect):—"Gov. Coolidge wishes me to reply to your telegram and say that the public utilities commission of Massachusetts, composed of chairman and four associate members, is a permanently established commission which has done excellent work. No intention in Massachusetts of doing away with this commission which has proven its usefulness."

James M. Cox, governor of Ohio (Democratic nominee for president in the last election):—"We have had a most satisfactory experience with our public utilities commission. In fact our state could not have done without it."

Albert E. Sleeper, governor of Michigan:—"Michigan created a railroad commission in 1911 and gradually extended its powers to include other utilities. In 1919 a new statute changed the railroad commission to a general public utility commission with broadened powers. I believe such a commission absolutely indispensable but its powers should be further extended. Believe our commission created in 1919 has been almost indispensable to the welfare of the state. State regulation certainly should be perpetuated."

Alfred S. Smith, governor of New York:—"The state of New York has been committed to the policy of regulating public utilities by commission since July, 1907. With comparatively few exceptions, this policy has worked very satisfactorily. At first, there were some conflicts in jurisdiction between the commission and localities but practically all of such defects in the law have been remedied by legislative amendment or by interpretation by the courts. I think I am justified in saying that the system has worked very satisfactorily in this state."

Hugh Dorsey, governor of Georgia:—"Our commission, the first ever created in the union, functions well. We would not consider repealing the law."

John H. Bartlett, governor of New Hampshire:—"We are well satisfied with our public service commission and believe that our method is the best way to regulate utilities."

Lynn J. Frazier, governor of North Dakota:—"Board of railroad commissioners consisting of three members regularly control and fix rates, charges and services of all public utilities. I believe that it is necessary to have some board with power to make those regulations."

J. B. A. Robertson, governor of Oklahoma:—"I think it very essential in these days to have a corporation commission or a similar board to regulate and control public utilities. While our commission has not given entire satisfaction, it is not the fault of the system so much as it is of recent conditions in the business world."

R. Livingston Beckman, governor of Rhode Island:—"Find our public utilities commission of three members a great success and can see no reason for abolishing the same."

Louis F. Hart, governor of Washington:—"Our experience with our public sevrice commission has been most satisfactory and its work has been of incalculable benefit to the people of our state."

William C. Sproul, governor of Pennsylvania:—"We have in this state a public service commission which has been extremely useful. We would not think of abolishing it."

H. D. Carey, governor of Wyoming:—"It would seem to me that for any state to do away with its public utilities commission would be a step backward. It is my intention to ask our legislature to increase the powers of our commission, although it has accomplished much under our present law."

S. Raymond Brooks, secretary, governor of Texas:—"The governor requests me to answer your telegram. As yet Texas has no public utility commission, but a bill looking to the creation of such a commission is likely to be introduced at the coming session of the legislature."

Percival W. Clement, governor of Vermont:—"Public service commission working out satisfactorily in this state. I am recommending increased authority and facilities to enable commission to investigate more thoroughly affairs that come to it for approval and regulation."

D. H. Ppjohn, secretary, governor of Oregon:—"Governor absent. Public service commission here has functioned successfully. Some efforts have been made to abolish it but have proved futile."

John J. Cornwell, governor of West Virginia:—"This state has had commission regulating all public utilities for ten years. It is indispensable and there is no sentiment for repeal of the law."

Simon Bamberger, governor of Utah:—"Public utilities commission established in Utah four years ago on the theory of urgent need for proper regulation and I cannot conceive justification for abolishment. Most decisions are bound to create a limited dissatisfaction temporarily but in the end the action almost without exception proves to have been warranted."

O. O. Larrazolo, governor of New Mexico:—"Corporation commission in New Mexico has not given all the good results it should for lack of sufficient power under the law. If properly empowered to act, I consider such a commission not only good but almost indispensable."

Samuel R. McKelvie, governor of Nebraska:—"Our railway commission constitutional body. Think it has done good work."

S. V. Stewart, governor of Montana:—"Montana's experience with public utilities commission has been entirely satisfactory."

E. D. Doyle, governor of Nevada:—"Nevada has had railroad and public utilities commission since 1907. In 1919 the name was changed and personnel slightly altered but functions remained the same. We consider it an indispensable department; first, because it keeps public service corporations out of politics; second, because it properly and intelligently represents the state before the Interstate Commerce Commission on all

interstate rates affecting our people third, because it effects by informal methods satisfactory adjustment of interstate rates and services; fourth, because it shuts out improper and destructive competition, and fifth, because it saves our industries and people hundreds of thousands of dollars annually. same need for a State Public Service Commission now as before the passage of the Esch-Cummins bill."

F. D. Gardner, governor of Missouri:—"We have in this state a public service commission of five members. It has been compelled, owing to the high cost of everything, to grant increased rates to public utility corporations. This has raised, of course, a clamor over the state, but thoughtful people and those who have studied the situation, in my judgment, realize that the situation would have been far worse without a public service commission. Personally, I most assuredly feel that the service commission is an important and necessary adjunct of a state government."

M. H. Holcomb, governor of Connecticut:—"Public utilities commissions has rendered valuable service in regulating trolley conditions and other pubilc utilities. Dispensing with the commission would not be considered."

Oliver H. Shoup, governor of Colorado:—"Colorado public utilities commission six years handled 380 formal and 1,100 informal cases besides many other matters not placed on the docket. Its experiences on account of rate advances necessitated by abnormal operating costs, in some instances, has been similar to that of other state commissions but the people of Colorado as a whole have evidenced confidence in the commission and its work. The efficiency of state regualtion has been proven in many cases of home rule. Study of its activities would show that in regulation and supervision of public utility service, even more than of rates, the commission is a source of daily usefulness to the public. No question but that state regulation of public utilities has proven its value here."

Carl E. Milliken, governor of Maine:—"We have a public utilities commission in Maine. I believe in that method of regulating public utilities."

L. M. Russell, governor of Mississippi:—"Our people are thoroughly satisfied with our commission and would not do without it."

John M. Parker, governor of Louisiana:—"Louisiana has had for a number of years a railroad commission in charge of railroad, telegraph, telephone and express utilities. It has been an invaluable arm of state government and there is no thought of dispensing with it."

Edwin P. Morrow, governor of Kentucky:—"Experience of Kentucky with railroad commission most satisfactory as far as powers extend."

Henry J. Allen, governor of Kansas:—"Kansas public utilities commission established in 1911. Over 4,000 cases have been taken before this commission with the number gradually increasing. Less than one percent of the cases appealed to the courts. Very few decisions reversed."

D. W. Davis, governor of Idaho:—"This state has public utilities commission of three members. We expect to continue this commission as I believe it would be a sad step backwards to do away with state regulation of utilities."

Frank O. Lowden, former governor of Illinois (message sent Dec. 24, a few days before his retirement):—"Of course there has been criticism of our public utilities law because of the necessity of increasing rates in consequence of the war. Up to two years ago, however, the decreases in rates were much more numerous and greater than the increases. It looks now as though it would be possible in the next few years for the commission to again reduce rates and indeed protect the public better than could be done without a commission."

James P. Goodrich, governor of Indiana:—"Our public utility commission has been in force in Indiana for the past ten years. Has given complete satisfaction. It is undoubtedly a great step in advance and will be retained in our state."

Thomas F. Kilby, governor of Alabama:—"The Alabama legislature created a public service commission in 1915. The commission did not give general satisfaction and the legislature in special session in 1920 placed additional duties upon it, increased salaries and required commissioners to live in Montgomery. My belief is under the present law better results will be obtained."

William D. Stephens, governor of California:—"The state railroad commission of California regulation of public utilities has justified its existence in every way. California is strong for just such a body."

T. E. Campbell, governor of Arizona:—"Am subscriber to principle of regulation of public utilities through properly constituted board or commission, preferably the latter."

Albert C. Ritchie, governor of Maryland:—"Maryland has had a public service commission since 1910 and state regulation is here to stay."

Eastern Indiana Association Meets at Noblesville

The annual convention of the Eastern Indiana Telephone Association was held at Noblesville on February 9 with an attendance of 100 representatives from as many telephone companies in central and eastern Indiana. The visiting representatives were entertained at dinner by the Kiwanis Club. City Attorney Neal delivered the welcome address and the response was made by Judge Clark, of Danville, Ind., attorney for the association.

Henry A. Barnhart, of Rochester, Ind., ex-representative in congress, delivered an address on "Congress in Action" and was followed by a talk on the manufacture and care of dry batteries by Prof. R. V. Achotz of Purdue university.

Among the telephone men of the state who attended the convention were M. F. Hosea, Indianapolis; C. C. Monticue, Newcastle; William F. Bailey, Richmond; C. M. Martz, Arcadia; Samuel Tomlinson, Plymouth; Claude Stoops, Nappanee; Frank Fouke, Sheridan; John M. Stanley, Ladoga; Ross Wickersham, Tipton.

Vail Service Medals

"Theodore M. Vail Distinguished Service Medals" are to be awarded each year to employes of the Bell telephone system for acts of an unusual character, according to an announcement just made by the officials of the American Telephone & Telegraph Co. and its associated companies.

The medals will be known as the Theodore N. Vail distinguished service medals.

A number of bronze medals will be available for distribution each year in each company associated with the Bell system. These medals will be accompanied by a citation of the circumstances which occasioned the award. A committee of award, appointed by the president of the associated company, will designate recipients of the medals and citations in that company. One-half of the medals will be for men and the other half for women.

In addition to the bronze medals available in the associated companies there will each year be available eight silver and two gold medals to be awarded by a Bell system committee appointed by the president of the American Telephone & Telegraph Co. The eight silver medals will be accompanied by cash awards of $250 and the two gold medals will be accompanied by cash awards of $500. Provision will also be made for a special distinguished service medal of gold, accompanied by a cash award of $1,000, to be presented for a very exceptional act or service if and when the committee deems an occasion deserves such recognition.

The Subscriber's Line Wires

Simple Explanation of System Which Connects With Switchboard in the Central Office—Courtesy Western Electric News

BEYOND a general notion that wires go into cables, and the cables go along streets or along alleys on lines of poles, it is something of a mystery to the uninitiated how the wires go from their houses and offices to the switchboard in the telephone central office. It is the purpose of this talk to trace the wires from the switchboard through the streets to the subscribers all over town.

The central office building is near the center of the town, or, if it is a large city with more than one central office, each is near the center of the community it serves. The wires leaving the central office are grouped into cables, each of which contains from 100 to 1,200 pairs of wires, one wire for each subscriber's line. In the case of large city offices with a great many heavy cables they start out from the central office in conduits.

In most places, however, the cables are carried on poles from the central office, and on poles in alleys and streets they branch out all over the town.

Some of the cables extend only a short distance before they are connected to telephones, others are carried on to the limits of the town or city. If we follow one of the large cables to the section it serves we shall find that it splits up into smaller cables, and these into still smaller cables, which spread out like the branches of a tree, so that every street has a cable large enough to serve not only the present subscribers, but all the subscribers that may be expected for some time.

Not all the cables, even in large cities, are buried underground. This would be expensive above all reason. In the largest cities the large cables are kept together in the principal streets as far as possible, and buried, but where they thin out very much it is better to carry them in the air. Just as quickly as possible they are put on poles and made into aerial cables.

In the heart of the big city's business district there are usually enough cables to have them entirely underground, and a small cable is led through an underground pipe into the cellar or outside rear wall of one or more buildings in each city square or block. The other buildings in the block are reached from this one.

In all places except in the largest cities the cables in the business district are carried on poles in the streets or alleys. Only the largest cities can pay the expense of an underground system.

In the residence districts of the larger cities, as well as in the towns, a small cable is brought on poles into each block behind the houses, where it is carried either on poles in the alley, if there is an alley, or on the back fences or back walls of the buildings.

The system of cables we have described, starting as a bunch of larger cables at the central office, and spreading out thinner and thinner over the city so there is a cable within easy reach of every building, in what may be called a permanent plant, which costs a great deal to install and is disturbed as little as possible except to add to it every few years. The telephones themselves are frequently moved and must be connected to the permanent cables by wires which can be installed, and later removed, if necessary, with moderate expense.

For this purpose each branch cable ends in what is called a cable terminal. This is an iron or wooden box in which the wires of the cable are separated, and provision is made so they can be easily connected to loose pairs of rubber and braid-covered wires, called drop wires, which run direct to the subscriber's premises.

Frequently short branches from a cable are led to different cable terminals in the same or adjacent city blocks, so that several telephones may be connected to the same pair of wires in the cable, to make a party line.

The terminal cables may be placed in the cellars of business blocks, hotels and large apartment houses, but in the residence districts they are usually outdoors and above ground, either on the poles or the back fences or back walls of buildings. The drop wires are run along walls or fences, or through the air, from the poles to the houses.

We have not yet described the cables and how they are carried in the ground or on poles. A cable consists of a bundle of wires in a lead pipe. Each wire is of pure soft copper, usually No. 22 B. & S. gauge (1-40 inch in diameter), and is covered with a wrapping of paper. The two wires for each subscriber's line are twisted together in a pair, to prevent cross talk. The largest cables contain 1,200 pairs, and many smaller sizes are used, down to 15 pairs.

At the ends of a cable, and wherever a smaller branch cable is spliced on to it, great care is taken to seal it against the entrance of any moisture, as the moisture would electrically connect all the wires in the cable and disrupt telephone service.

Where the cables are to be placed underground a trench is dug and the required number of conduits or ducts, usually made of hard baked clay, are laid in and cemented together, so as to make long, smooth pipes, one for each cable. At the street crossings or other frequent intervals the ducts run into underground chambers of brick or concrete with iron covers. These are called manholes and give access for splicing on branch cables or pulling in additional cables as needed.

Where the cables are to be carried overhead poles are erected and a strong steel rope called a messenger strand is strung along from pole to pole. The cable hangs from this by galvanized hooks or rings about every eighteen inches.

We will now describe how the wires in the lead-covered cables, bunched together at the central office building, are connected to the switchboard in a flexible manner so that only the wires actually in use are connected to switchboard lines, and so that when a subscriber moves to another neighborhood and is connected to a pair of wires in another cable this new pair of wires can be connected to the same old number in the switchboard.

For this purpose an iron framework called a main distributing frame is provided in the central office. The cables from the street are brought to one side of this frame and the wires are separated and soldered to little metal points called terminals. Other cables from the switchboard are brought to the other side of the main distributing frame and their wires are similarly separated and soldered to other terminals. Then each working line in the street cables is connected to the switchboard line of the proper number by means of a loose pair of wires called cross connecting jumpers.

On the main distributing frame are mounted also the protectors, one for each line, which keep lightning and other dangerous currents which may get on the street wires from getting to the apparatus in the central office.

Troubleman's Test Set

Stewart Bros., Ottawa, Ill., have devised a test set which will watch the line for the lineman; that is, the test set will lead the lineman to the trouble over the shortest route without opening the line. When the lineman comes to a branch line, the test set will tell whether or not the trouble is down the branch, without opening the line. Where a line runs three ways, the lineman will know which way to go without opening the line.

The surprising statements of the manufacturers of the test set in the opening paragraph are based upon the fact that the lineman can climb a pole at any point along the line and, by use of the test set, tell which way the trouble is from him and about how far. A lamp is so arranged that when a line is clear it will not show when the crank is turned. If there is trouble, the lamp will show in brightness according to the distance the trouble is from the tester. The test set works on either grounded or metallic lines.

Fig. 1 shows the connections for telling which way a short-circuit is from the tester, and Fig. 2 the connections for locating a ground. It will be noted that in locating a ground, one side of the set is connected to a ground wire, guy wire, or any other good ground connection.

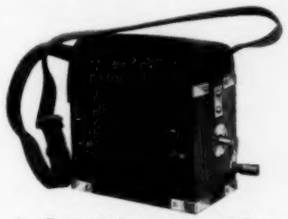


Fig. 3—General Appearance of Stewart Bros. Test Set.

Fig. 3 shows the general appearance of the set. It has a leather top cover to protect it from the dust and weather when not in use. It comes all complete with all cords and clips ready for use. The set is equipped with full talking apparatus, having transmitter, induction coil, receiver, battery, generator, etc. The battery used is of ample size and will not freeze dry, and has lasted, in many cases, two years.

Fig. 4 — Troubleman Ringing with the Stewart Test Set.

The set is compact and light of weight, and will stand any reasonable wear and tear.

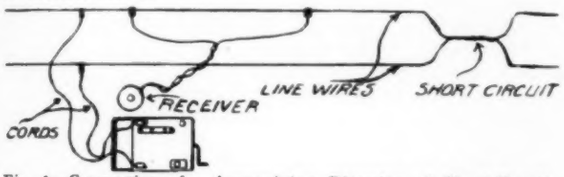


Fig. 1—Connections for Ascertaining Direction of Short-Circuit.

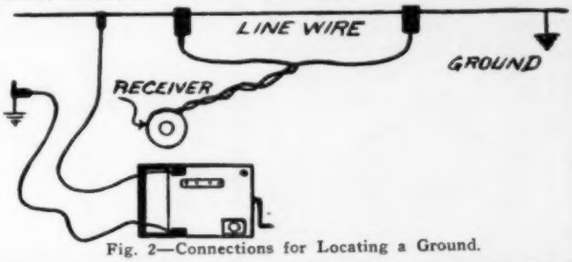
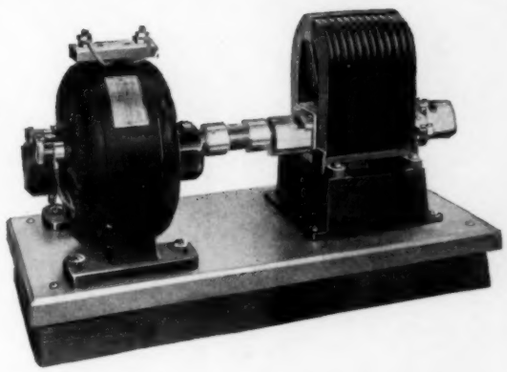


Fig. 2—Connections for Locating a Ground.

THE HOLTZER-CABOT MAGNETO RINGING MOTOR-GENERATOR

Gives Uniform Ringing Current

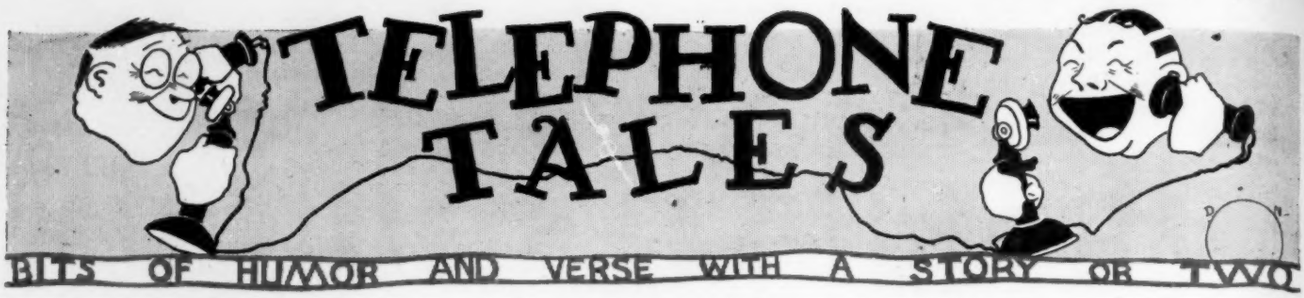
The Holtzer-Cabot Magneto Ringing Motor-Generator, which operates direct from the lighting circuit, and independently of a battery or contact auxiliary, insures the uniform ringing current that every exchange desires.



Prompt delivery can be made from stock

THE HOLTZER-CABOT ELECTRIC COMPANY

BOSTON CHICAGO DETROIT NEW YORK
PHILADELPHIA BALTIMORE ST. LOUIS MINNEAPOLIS



"Excuse It, Please"

Upon a midnight, cold and clear,
When slumber marks you for its own,
You waken, with a start to hear
The tinkling of the telephone—
A sound that, heard in broad daylight,
Possesses a peculiar charm,
But, in the watches of the night,
Invests your soul with wild alarm.

You rise with palpitating dread
And, through the deep and spectral gloom,
You stagger from your downy bed
Unsteadily across the room.
And standing in the wintry breeze
Your nightie flapping to and fro
Athwart your weak and trembling knees,
You feebly cry, "Hello! Hello!

"Hello! Hello!" you feebly cry
With chilling shanks and rising ire.
But you elicit no reply
Except the singing of the wire.
Until in soothing tones and low,
As if your troubled soul to ease,
A lady answers your "Hello"
And shortly says, "Excuse it, please!"

"Excuse it, please!" when one is torn
From gentle slumber's twilight zone
As frightened as if Gabriel's horn
It's awful reveille had blown-
When ripped untimely from his bed,
When every nerve that he has got
Is set on edge with cold and dread,
Will he excuse it? He will not!

* * *

How can you hear a nickel ring three miles? Drop it in a pay station.

* * *

Wouldn't it be a wonderful world if telephone subscribers would wait for a telephone connection with the same patience they wait to get into a moving picture theater.

* * *

Worth Studying

A lady observing a mule owned by a colored boy asked: "What do you call your mule?"

"I calls him Utility."

"How did you come to give him such a name?"

"I'se been studin' de animal and readin' de papers. Dat mule gets mo' blame an' abuse dan anything else in de city an' goes ahead doin' his level best just de same."—Wall Street Journal.

* * *

Gathering the News!

What would Reporters do these days,
When nose for news is all the craze—
When sixteen columns to each man
Is quite a small assignment plan,
And when editions come each hour
From presses of the highest power,
And people, anxious, on the street,
Are grabbing for the latest sheet
To know just what is going on,
From Hackensack to Old San Juan—
I say, how would they make the grade
If TELEPHONES had not been made?
—Rips.

* * *

She Had "Wheel" 'Phone

A woman subscriber called the district wire chief's office at Eighth and Cedar streets one day.

With his usual alacrity and modulated voice, Gilmore Johnson, chief clerk, answered the telephone.

"My telephone is out of order and I can't make it go," said the w. s.

"What kind of trouble are you experiencing?" said Gilmore.

"I have a 'wheel' phone and the 'wheel' won't go around," she answered.

Whether Gilmore sent a repairman to grease the "wheel" or not we don't know, but he assured us he had it fixed. —The Emblem.

* * *

Sonatina in A Flat

I caught her gently as she fell,
I held her tenderly,
While she, fair words and sweet to hear,
Let fall so gently in my ear,
A-tingling with some strange emotion,
Some vibratory, rhythmic motion,
As I held her tenderly.
Was she so true as words would tell?
Or was she false deceiver?
So dark yet lustrous to behold!
So slender—yet so strong, so bold!
One silken tress fell o'er my hand.
Ah! False or true— I understand
My telephone receiver.
—New York Globe.

Love's Labor Lost

A successful old lawyer tells the following story anent the beginning of his professional life:

"I just had installed myself in my office," he said, "had put in a telephone and had preened myself for the first client who might come along when through the glass of my door I saw a shadow. Yes, it was doubtless someone to see me. Picture me, then, grabbing the nice, shiny receiver of my new telephone and plunging into an imaginary conversation. It ran something like this: 'Yes, Mr. S.,' I was saying as the stranger entered the office: 'I'll attend to that corporation matter for you. Mr. J. had me on the telephone this morning and wanted me to settle a damage suit, but had to put him off, as I was too busy with other cases. But I'll manage to sandwich your case in between the others somehow. Yes. Yes. All right. Good bye.' Being sure, then, that I had duly impressed my prospected client, I hung up the receiver and turned to him. 'Excuse me, sir,' the man said, 'but I'm from the telephone company. I've come to connect your instrument'."—China

* * *

Your Telephone

I am only a telephone. When I am not broke I am in the hands of the receiver. I have a mouthpiece, but unlike a woman, I never use it. Some fellows use me to make dates with girls, and girls use me to break said dates. Husbands call up their wives over me; wives call down their husbands over me. I never go anywhere but sometimes the company comes, and takes me out—it all depends on whether you pay your bill or not. I am not a bee, but I often buzz in your ear. I am the bell of the town and while I do not wear jewelry, I often get rings. Whether I do things or not, a lot of people nail mail to the wall. I like music but the only music I ever hear is chin music. I get all the popular airs, but the most popular one is hot air.—Exchange.

* * *

The girl at the switchboard who gives you your number is called an operator, but she really is a "co-operator."

MAGNAVOX ANTI-NOISE DESK TELEPHONES

A "close-up" of the Magnavox anti-noise desk telephone, Type B-1. The receiver moves freely on a spring ball joint. The anti-noise transmitter is adjustable in the mounting sleeve.

GIVE

Absolute Elimination of Side Tone and all Outside Noise.

Because of Anti-Noise Transmitter.

In the noisiest shops or offices the voice alone comes through clear as a bell. By its construction nothing else can affect the diaphragm.

We will be pleased to supply further information and quote prices on any quantity for immediate shipment.

The Magnavox Company : : Oakland, California

The Passing of the Wood Telephone Cabinet

Magneto Steel Wall Telephone Type No. 315.

We manufacture and sell many wood cabinet telephones, but—wood suitable for the manufacture of telephone cabinets is practically exhausted—will soon be impossible to buy at any price. Steel cabinets must eventually be used. Why not begin now to use the **Federal** Steel Telephones? Lower in price, higher in quality.

Federal Telephone & Telegraph Co.

Buffalo, New York

Telephoning and Its Relation to Business

An Article in Telephone Talk Advocating Teaching in Public Schools the Art of Telephoning

SOME DAY the art of telephoning will be taught, if not in public schools, at least in those institutions which inculcate in progressive young people the first principles of business. In schools and colleges much attention is paid to instructing pupils in stenography, typewriting and bookkeeping; but telephoning, which has as much to do with the proper and successful conduct of business as anything else, is left to be picked up after a student has graduated and entered an office. Until such times as instruction in telephoning is added to the curriculum of business colleges, the assistant in a business office must learn by experience.

That good telephone service in an institution is a definite factor in its success is brought to mind by an article in October *System* magazine by Miss Myrtle Smith, chief operator of the Cadillac Motor Company. She writes at some length to show how the private branch exchange system of that company has been improved, developed and kept up to a pitch which assures the management that it is getting good service. Private branch exchanges in a city are many in number, and Miss Smith's article contains many suggestions of value to those who make an annual appropriation for the purpose of expediting business between the firm and the patron on the outside:

"When a business man who has a private branch telephone exchange lifts the receiver off the hook, he expects an immediate answer. When he has given his call to the operator he expects service; his call must be followed, and he wants a report on it without delay. That is why he has a private branch exchange—P. B. X., for short. But how many really get this service? Not many.

"When someone from outside calls this man, is the call put in personally, or does this outside party have to tell his secretary to try to put this call through? Too often the secretary has to do the calling.

"I know these unsatisfactory conditions exist, because I have come in contact with them in many companies. In fact, it is the daily failure of many P.B.X.'s that takes me to them in something of an advisory capacity, and almost invariably the local telephone company gets the blame for all the poor service outside the company, when usually the trouble is right in the P.B.X. service.

"Men 'put up' with wretched service day after day, while they try to fix the blame for it on someone outside of their own organization. And usually the remedy lies right there within their own reach.

"The private branch exchange, the door through which comes much of your business, can be an attractive entrance that welcomes callers, or it may act as a formidable barrier to those who try to approach you; made one of the most convenient and valuable instruments that help you conduct your business every day, one of service to yourself and those who do business with you, and a thing of practical economy for your company."

EPIGRAMS BY THEODORE N. VAIL

"Qualifications of a high-salaried man: He must have ability, judgment, courage, enthusiasm, self-confidence, energy, initiative, foresight, experience, a great knowledge of human nature and personality enough to be a real leader of men.

"He must take infinite pains in small things as well as in large. He must demand of himself as well as of others nothing but the best.

"He must have backbone and a real desire not only to excel but to serve.

"Imagination is like a very spirited horse—most valuable where the horse is useful, but it must be harnessed, saddled, and bridled. Without saddle, bridle, or harness or complete control, a splendid horse would, if you tried to use him, only destroy, not accomplish.

"Reflection:—Without reflection, observation or imagination is useless, and without concentration reflection is valueless.

"Memory Cultivation: — Memory is valuable, but don't load your mind with immaterial things or things where correctness and exactness are essential and which can be easily obtained from a reference book.

"Let a young man see to it that he increases his earning power to the highest point of which he is capable, and a salary commensurate with his worth will be forthcoming sooner or later—sooner rather than later, as a rule."

"I would emphasize that it will be your own actions and the experience and knowledge gained from them, that will mould you and make for you your place as active, responsible members of society.

"Every act, small or great, will have some influence on your future; it will have its part in the formation of your character. Be careful, therefore, that each act is a rightful act, and one that will be part in the formation, for you, of a good and worthy character and reputation."

In describing the service of the Cadillac company it is pointed out that reliance is not placed on printed instructions. While these are of value as far as they go, the great thing is to study the peculiarities of the service of each particular office, and, further, to study the cranks of those who cause trouble. In the latter instance, the manner to be adopted to secure the best service is discussed with the person concerned. Anyone experiencing difficulty with his telephone messages is given the chief operator, who acts as a sort of shock absorber. After explaining to the person who is "up in the air" how useless it is to take up central's time, she offers to get the number wanted. After he sees how easy it is to get the right service, this subscriber automatically becomes a co-operator.

It is contended that these personal explanations count, as the person's wrong methods are picked out and he is shown how to correct them.

It sounds rather odd for a girl in charge of a P.B.X. to correct men who should have businesslike methods, but it is very probable that few of us are so right in our telephoning but that correction would be in order if we would accept it in the spirit with which it is tendered.

The article goes on to explain what effort is taken to have the business looked after, how the operators are coached, not only in general routine, but in matters that develop daily; how enthusiasm is maintained in the operating force; in short, the methods are detailed of a bright girl whose idea is to give a service on a par with what the head of the business would have in any department. The article is instructive and contains many ideas for the constructive mind.

Aw, Shucks!

An operator in Des Moines worked for some time on a long-distance call for a subscriber, but was unsuccessful in reaching the called party. Report charges were not in effect at the time, and after the operator had given the last report to the subscriber he asked, "Any charges, Central?" She answered, "No, sir." Then he said, "Wait right here on the line, will you?" She told him "Yes" and heard him deposit a dime and a nickel. Then he said, "That's for you," and hung up.—Northwestern Bell.